sub-Atlantic

www.sub-atlantic.co.uk

Performance

Hydraulic Propulsion Selection Manual for Engineers

Revision 3 APR. 2003

Sub-Atlantic Limited, Unit 12, Airways Industrial Estate, Pitmedden Road, Dyce, Aberdeen, AB21 0DT Scotland UK			
Tel: +44 (0)1224 723623	**Fax:** +44 (0)1224 723822	**Email:** sales@sub-atlantic.co.uk	**Web:** www.sub-atlantic.co.uk

Revision Record

Rev	Description	By	Date
1	Original	cmi	
2	SA300-20 and SA380-40 data added	cmi	Dec 02
3	Sa420-40 data added	cmi	11/04/03

Propulsion Products

Since their launch in 1998, Sub-Atlantic's 'SA' range of hydraulic thrusters have been selected for approximately 90% of new build cable burial/maintenance vehicles. Working in this highly aggressive environment, they have become renown for their reliability, efficiency and exceptional performance. The ROV sector is now also recognising the considerable benefits to be gained, having been selected for the majority of 'new design' systems such as Stolt Offshore's, *'SOLO Mk II'*, Thales Geosolutions's *'G3'* or Deep Ocean's *'Installer'*.

'SA' Range of Hydraulic Thrusters

We offer a ***'Preferred Range'*** and a ***'Non-Standard Range'*** of hydraulic thrusters.

Our ***'Preferred Range'*** is available in four sizes, SA300-30, SA380-40, SA420-60 & SA500-110, where the first number represents the diameter of the propeller in millimetres and the second, the motor displacement in cubic centimetres. The SA300 and SA380 units are usually used on work ROVs, the SA420 and SA500 for cable ROVs.

Our ***'Non-Standard Range'*** is available in a number of different options of motor displacement, propeller size, motor manufacturer and mounting style. In certain cases, we can also produce specials to customer's requirements. Details of the SA-300-20cc and SA-380-30cc are shown in this manual.

When selecting hydraulic propulsion thrusters for an underwater vehicle design, many highly important considerations such as efficiency, pressure and flow, weight, size and forward/reverse characteristics must be taken into account. Failure to correctly interpret these or to use inaccurate data will result in a system with inferior performance and incapable of meeting your expectations.

During the development phases of the 'SA' range, Sub-Atlantic evaluated various competitor's thruster products. We found that the actual test results and weights proved to be vastly different from the data claimed in their technical publications.

Infact, some of the data proved to be theoretically impossible to achieve. Sub-Atlantic therefore introduced a policy to ensure that all our own test performance data was witnessed by a reputable third party certification organisation (DNV). It is this commitment and confidence in our product that will give you peace-of-mind. Remember and ask for independently witnessed test data before you purchase your system or better still, test it yourself. If they can't provide it, ask the question "why not"!

Main Features

In addition to peace-of-mind, our hydraulic thrusters will provide you with the following benefits:

Proven Reliability

Originating from the design of the shaft sealing system which utilises hard, non-wearing ceramic and PTFE materials. Secondly, a rugged VOAC bent axis piston motor is used, capable of clocking up tens of thousands of trouble-free hours. We know SA thrusters are reliable because we sell very little spare parts!

More Efficient

Our thrusters convert more thrust from the available hydraulic power supply.

Superb Forward/Reverse Characteristics

Comparing input power to the output thrust, our forward and reverse thrust curves fall within a 5% band. This is important in a typical vectored configuration, as the overall system performance will only be as good as the average forward/reverse thrust. For the same power input, SA performance far exceeds other thrusters on the market. Check out the comparison graph.

Lighter

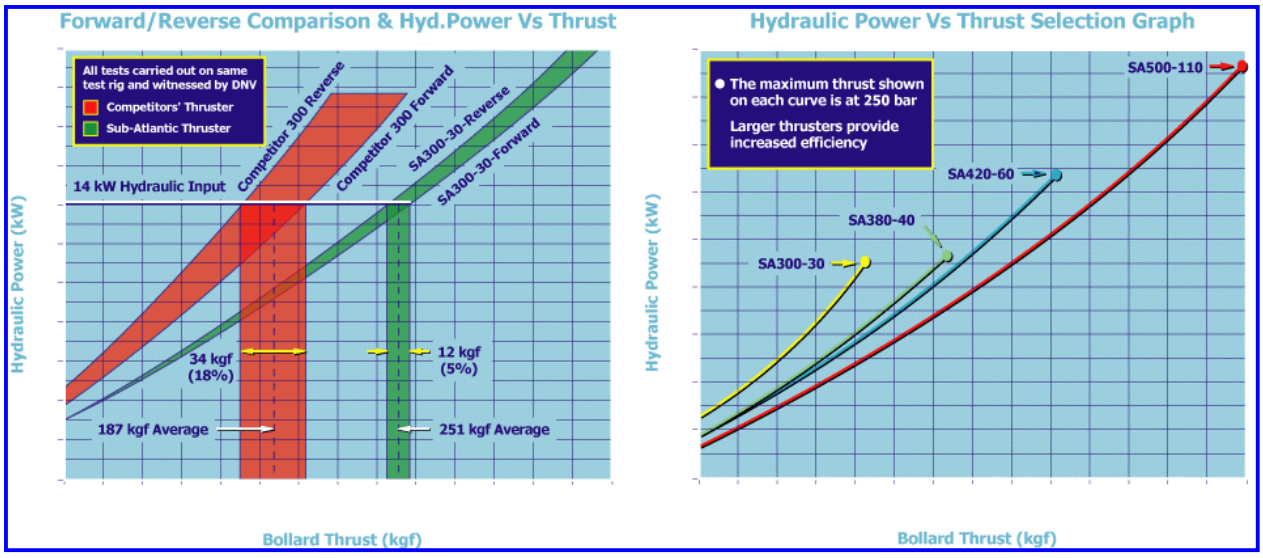
This means less ROV buoyancy required, less in-water drag leading to more usable thrust which means you will still be working when the increasing current puts the other back on deck.

DNV Witnessed Performance

Unlike some others, our thusters will perform just like we say they will.

Retro-Fittable

SA thrusters use common mounting configurations so ROV performance upgrades are easy.



Preferred Range

The standard Range consists of the following four units: -

Preferred Range						
Model	Propeller Diameter mm	Motor Displacement cc	Bollard Thrust @ 250bar kgf	Weight in Air kg	Weight in Water kg	Mount
SA-300-30	300	28.1	370	18	10	Flange
SA-380-40	385	37.7	460	27	14	Flange
SA-420-60	420	58.2	590	34	17	Flange
SA-500-110	500	110.1	850	59	31	Flange

These are the most common types available and should be selected where possible.

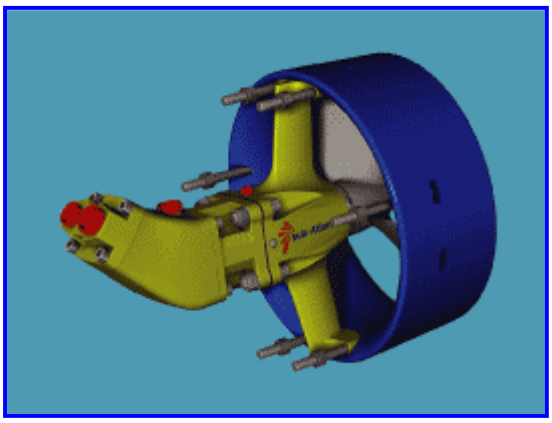
Non-Standard Range

Different Motor/Propeller Combinations

The VOAC motors used all have identical mounting interfaces to the thruster body, no matter the motor displacement. This makes them particularly suitable for interchanging with different propeller sizes to obtain higher running efficiencies. For example, in an application where limited hydraulic power and oil flow is available but maximum thrust is required, an SA-380-40 thruster (which normally uses a 37.7 cc motor) can be simply fitted with a 28.1 cc motor and used instead of an SA300-30. By using the larger propeller, increased efficiency can be achieved without the requirement for more oil flow. Details of these are shown in this manual.

SA-300/1002-(20 or 30)

This is a version of the SA-300 with special mounting configuration to fit Innerspace 1002 brackets. This is a particularly useful option for carrying out a quick retrofit on ROVs with frames with permanently welded thruster brackets such as 'Cobra'. Four to eight mounting studs can be positioned to suit. The motor can be 20 or 30cc displacement depending on the oil flow available.



Non-Standard Range						
Model	Propeller Diameter mm	Motor Displ. cc	Bollard Thrust @ 250bar kgf	Weight In Air kg	Weight in Water kg	Mount
SA-300-20	300	19.0	230	17	9	Flange
SA-380-30	385	28.1	330	26	13	Flange
SA-300-1002-20	300	19.0	230	17	9	Innerspace
SA-300-1002-30	300	28.1	370	18	10	Innerspace

Different Motor Manufacturers
Thrusters are also available with conversion kits which allow different motors to be used, such as Rexroth. Contact and we will advise you of these options.

Special Sizes
In certain cases, we may be able to supply special sizes.

Testing

Sub-Atlantic thrusters are tested at a depth of approx. 2.7 metres below the surface. The general procedure is illustrated on Drawing No. 0438-GA attached. All testing is witnessed by DNV who issue a certified certificate of authenticity.

Installation Drawings

The following General Arrangement drawings are attached: -

Model	Drawing No.
SA-300	**0283-GA**
SA-380	**0313-GA**
SA-420	**0301-GA**
SA-500	**0431-GA**
SA-300-1002	**1412-GA**
Thuster Test Rig	**0438-GA**

Performance Graphs

Comprehensive graphs are attached which allow an engineer to fully quantify performance at bollard condition through to 6 knots advance speed.

SA-300 Thrust versus Hydraulic Power
SA-300-30 cc Thrust versus Pressure & Flow @ 0 Knots
SA-380-30 cc Pressure versus Thrust & Flow @ 0, 1.5, 3.0, 4.5 & 6.0 Knots
SA-380 Thrust versus Hydraulic Power
SA-380-40 cc Thrust versus Pressure & Flow @ 0 Knots
SA-380-40 cc Pressure versus Thrust & Flow @ 0, 1.5, 3.0, 4.5 & 6.0 Knots
SA-420 Thrust versus Hydraulic Power
SA-420-60 cc Thrust versus Pressure & Flow @ 0 Knots
SA-420-60 cc Pressure versus Thrust & Flow @ 0, 1.5, 3.0, 4.5 & 6.0 Knots
SA-500 Thrust versus Hydraulic Power
SA-500-110 cc Thrust versus Pressure & Flow @ 0 Knots
SA-500-110 cc Pressure versus Thrust & Flow @ 0, 1.5, 3.0, 4.5 & 6.0 Knots
SA-300-20 cc (non-standard) Thrust versus Pressure & Flow @ 0 Knots
SA-380-20 cc (non-standard) Pressure versus Thrust & Flow @ 0, 1.5, 3.0, 4.5 & 6.0 Knots
SA-380-30 cc (non-standard) Thrust versus Pressure & Flow @ 0 Knots
SA-380-30 cc (non-standard) Pressure versus Thrust & Flow @ 0, 1.5, 3.0, 4.5 & 6.0 Knots

Other Equipment Available

Servo-Valve Pack

This extremely compact servo valve pack weighs only 32 kg in air, 15 kg in sea water and measures 775 x 198 x 213 mm. This valve pack is generally used to provide precise control of the propulsion thrusters on underwater vehicles. The pack utilises 77 LPM rated servovalves which provide low pressure drop on most standard ROV applications. The use of this pack in conjunction with Sub-Atlantic's efficient thrusters and hydraulic power units, will produce an unbeatable propulsion solution with regard to reliability, efficiency and cost.

The valves can also be used to control any tool requiring a vazriable speed or reversible function.The unit can use Star or Moog (Ultra) valves. Unless specified, Sub-Atlantic supply the Star valve as standard as this is half the weight of the Moog. Both types of valve are functionally identical and interchangeable.

Features: -

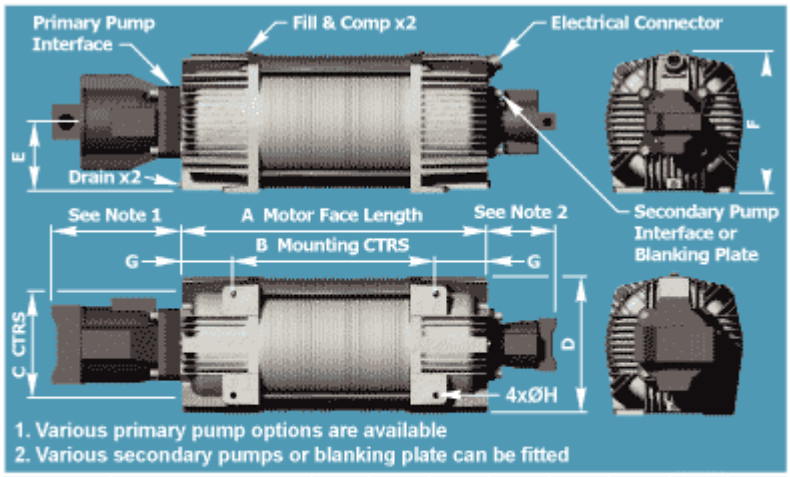
- **Compact and Lightweight**
- **280 Bar maximum input pressure, 350 LPM maximum input flow rate**
- **Pressure Relief Valve provides pump protection**
- **Integral Soft Start Valve or Pump Remote Control Valve options**
- **'STAR' lightweight Servo Valves rated 77 lpm full flow @ 70 bar pressure drop**
- **Water Ingress Sensors located to suit all mounting orientations.**
- **Temperature Sensor fitted to the return oil galley.**
- **Various Control System Options**
- **Integral Cover Relief Valve**
- **Fully Captive Screw Assemblies. No more lost screws!**
- **Lightweight Plastic Cover shaped to provide easy air bleeding and draining.**
- **Options available**

For full installation details, schematics, drawings, etc, request User Manual Doc. No. 1218-UM

75 & 110 kW Hydraulic Power Units (HPU)

These HPUs are ideal for driving thruster systems and hydraulic tools requiring higher power inputs. The submersible motor unit can also be used to drive other types of rotating machinery such as water pumps for trenching machines. The motor uses a Zeihl-Abegg rotor/stator unit which has for many years been successfully used in the ROV industry. The standard motor is 4 pole, 3000 vac running at 1700 rpm full load speed @ 60Hz. Other voltage and speed options are available on request.
The motor body and end cap design provides for efficient heat dissipation, which is essential when working in hot climates. Motor winding temperature and water ingress sensors are included for connection to customers control system. The motor is filled with transformer or hydraulic oil which must be positively compensated (compensators are available, see Hydraulic Products Brochure).

Various hydraulic pumps can be fitted to the motor by means of an Interface Plate. A secondary pump can also be fitted to the opposite end of the motor to provide a separate isolated hydraulic circuit. Compensated pumps are generally used which automatically 'unload' when there is no power demand. Pumps from different manufacturers such a VOAC or Rexroth in various sizes and control options can be supplied fitted and ready to run.

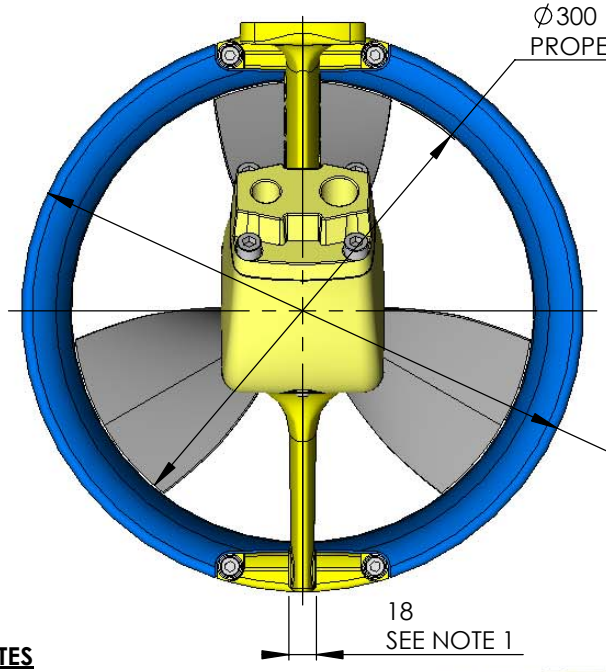


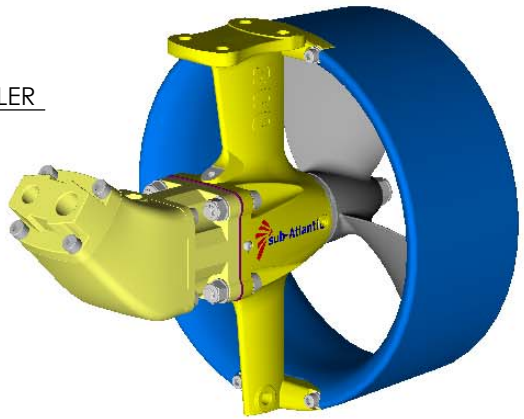
Part No.	Motor Shaft Power	A	B	C	D	E	F	G	H
1194-MAS	75kW (100HP)	765	510	220	310	160	322	127.5	Ø14
1193-MAS	110kW (150HP)	885	560	280	380	195	395	147.5	Ø18

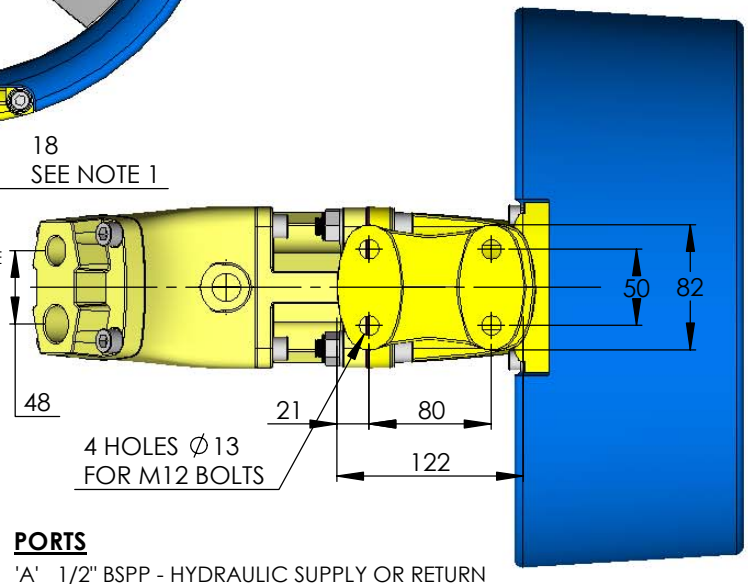
Typical Pump Options Available Sizes (cc)
VOAC PV Range 16, 20, 23, 32, 40, 46, 63, 80, 92, 140, 180, 270
Rexroth A10VSO Range 28, 45, 71, 100, 140

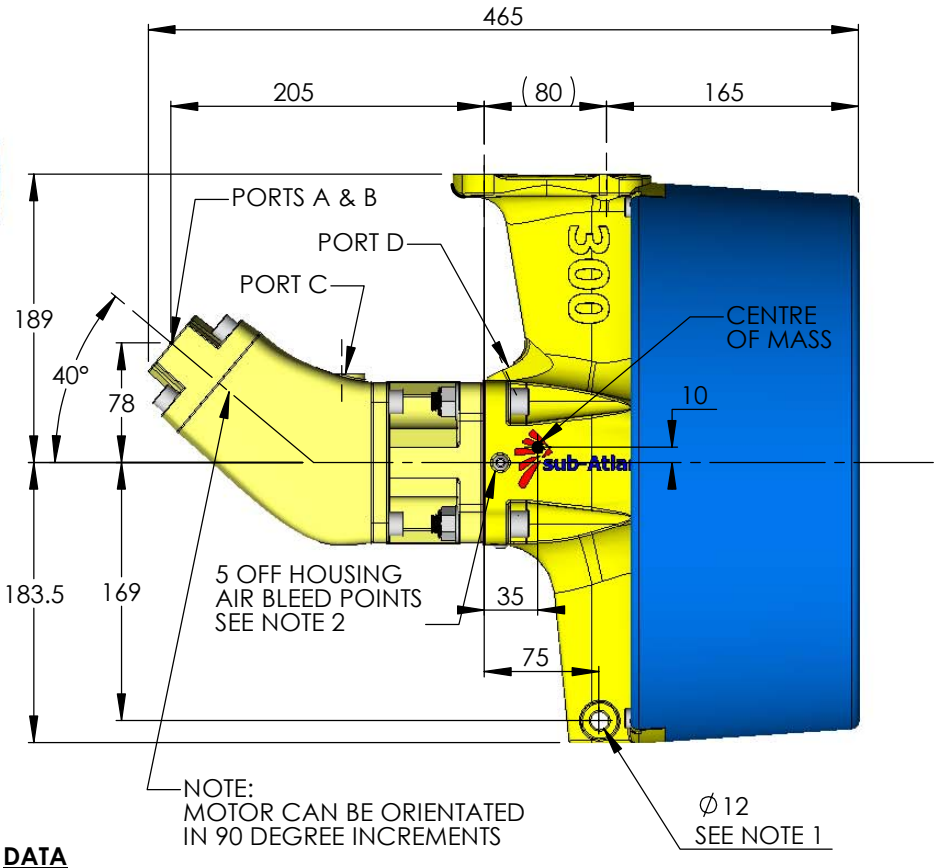
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF SUB-ATLANTIC LTD. ANY REPRODUCTION IN PART OR WHOLE WITHOUT THE WRITTEN PERMISSION OF SUB-ATLANTIC IS PROHIBITED

THIRD ANGLE PROJECTION









NOTES

1. THRUSTER IS FIXED BY 4 OFF M12 BOLTS TO HOST STRUCTURE. IF REQUIRED ADDITIONAL M10 BOLT CAN BE FITTED THROUGH THE TORQUE RESTRAINT HOLE. USING THIS HOLE WILL ELIMINATE TORQUE EFFECTS TO THE HOST STRUCTURE BUT IS NOT REQUIRED FOR THRUSTER STRENGTH.

2. BEARING HOUSING IS SUPPIED WITH 5 OFF AIR BLEED POINTS POSITIONED TO ALLOW THE REMOVAL OF AIR WITH THE THRUSTER MOUNTED IN ANY ORIENTATION. TWIST SCREW ONE TURN TO BLEED AIR THEN TIGHTEN.

3. ENSURE THAT THE MOTOR CASE DRAIN PORT 'C' IS FILLED WITH HYDRAULIC OIL PROIR TO INITIAL START-UP AND SYSTEM COMMISSIONING.

PORTS

'A' 1/2" BSPP - HYDRAULIC SUPPLY OR RETURN
'B' 3/4" BSPP - HYDRAULIC SUPPLY OR RETURN
'C' 1/2" BSPP - MOTOR CASE DRAIN
'D' 1/8" BSPP - BEARING HOUSING OIL SUPPLY

DATA

WEIGHT IN AIR:	17.4 kG
WEIGHT IN SEA WATER:	9.8 kG
MAX. CONTINUOUS PRESSURE:	250 BAR (Higher Possible - Consult Tech. Dept.)
MAX. CONTINUOUS FLOW:	56 LPM
THRUST, PRESSURE, FLOW:	REFER TO DATA SHEET

OTHER THRUSTERS AVAILABLE : SA-380, SA-420 & SA-500, SA-300-1002 INNERSPACE REPLACEMENTS & OTHER SPECIALS. ASK FOR DATA SHEETS

REV	BY	DATE	DESCRIPTION	APP
2	EBR	6/09/02	NOTES UPDATED	CMI
1	CGM	30/09/98	APPROVED FOR CONSTRUCTION	

RECORD OF REVISIONS

MATERIAL: ALUMINIUM, STAINLESS STEEL & PLASTICS

FINISH: HARD ANODISING & POWER PAINT COATINGS

USO, TOLERANCES TO BE

WT AIR	WT WATER
- kg (E)	- kg (E)

DRAWN	CGM
DATE	30/09/98
CHECK	SSM
APPRV.	CMI
ENGR.	CGM

sub-Atlantic
Unit 12, Airways Industrial Estate
Pitmedden Road, Dyce.
Aberdeen. U.K. AB21 0DT
Tel: ++44 (0) 1224 723623
Fax: ++44 (0) 1224 723822

SCALE (USO) 1 : 3.5 | ORIG. SIZE A3

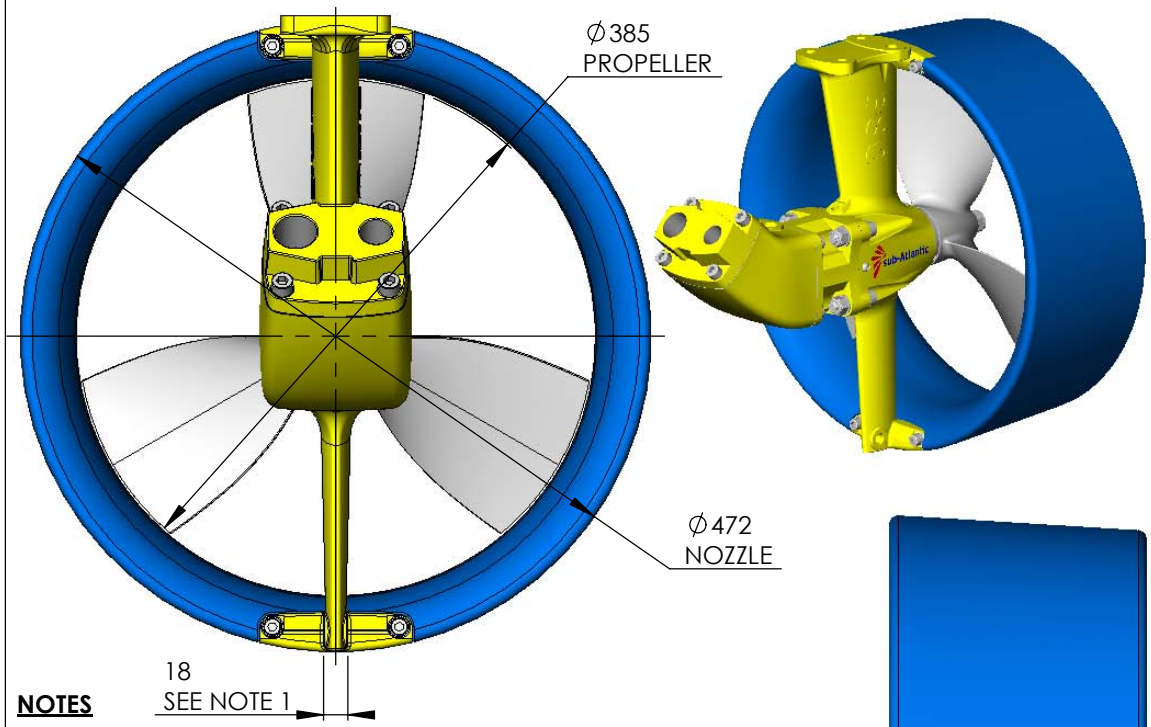
PROJECT: HYDRAULIC THRUSTERS

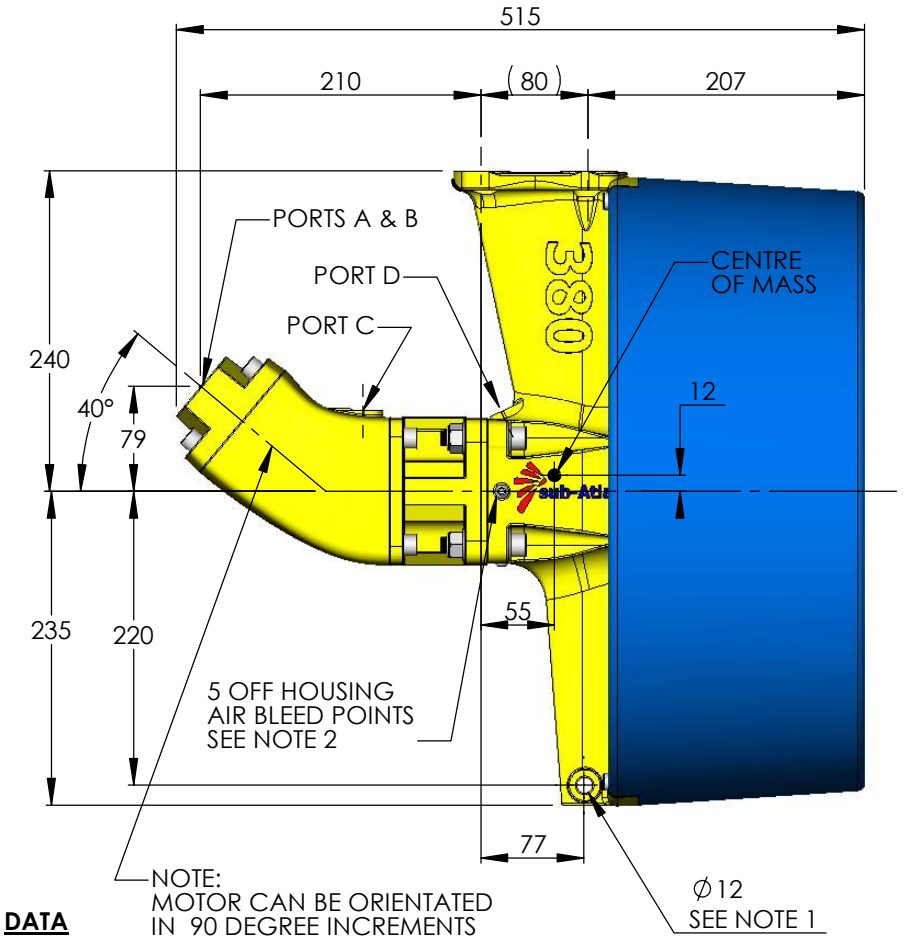
TITLE: SA-300 HYDRAULIC THRUSTER GENERAL ARRANGEMENT & INSTALLATION DRAWING

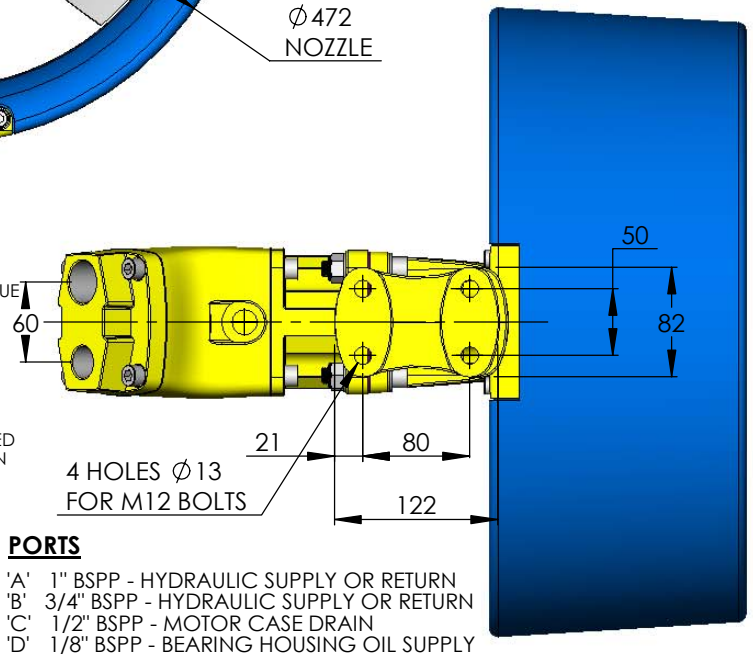
DOC. No. 0283-GA | SHEET 1 of 1 | REV 2

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF SUB-ATLANTIC LTD. ANY REPRODUCTION IN PART OR WHOLE WITHOUT THE WRITTEN PERMISSION OF SUB-ATLANTIC IS PROHIBITED

THIRD ANGLE PROJECTION







NOTES

1. THRUSTER IS FIXED BY 4 OFF M12 BOLTS TO HOST STRUCTURE. IF REQUIRED ADDITIONAL M10 BOLT CAN BE FITTED THROUGH THE TORQUE RESTRAINT HOLE. USING THIS HOLE WILL ELIMINATE TORQUE EFFECTS TO THE HOST STRUCTURE BUT IS NOT REQUIRED FOR THRUSTER STRENGTH.

2. BEARING HOUSING IS SUPPIED WITH 5 OFF AIR BLEED POINTS POSITIONED TO ALLOW THE REMOVAL OF AIR WITH THE THRUSTER MOUNTED IN ANY ORIENTATION. TWIST SCREW ONE TURN TO BLEED AIR THEN TIGHTEN.

3. ENDURE THAT THE MOTOR CASE DRAIN PORT 'C' IS FILLED WITH HYDRAULIC OIL PROIR TO INITIAL START-UP AND SYSTEM COMMISSIONING.

PORTS

'A' 1" BSPP - HYDRAULIC SUPPLY OR RETURN
'B' 3/4" BSPP - HYDRAULIC SUPPLY OR RETURN
'C' 1/2" BSPP - MOTOR CASE DRAIN
'D' 1/8" BSPP - BEARING HOUSING OIL SUPPLY

DATA

WEIGHT IN AIR:	27 kG
WEIGHT IN SEA WATER:	14 kG
MAX. CONTINUOUS PRESSURE:	250 BAR (Higher Possible - Consult Tech. Dept.)
MAX. CONTINUOUS FLOW:	70 LPM
THRUST, PRESSURE, FLOW:	REFER TO DATA SHEET

OTHER THRUSTERS AVAILABLE: SA-300, SA-420, SA-500, SA-300-1002 INNERSPACE REPLACEMENTS & OTHER SPECIALS. ASK FOR DATA SHEETS

REV	BY	DATE	DESCRIPTION	APP
2	SSM	05/09/2002	EXTRA NOTES ADDED	CMI
1	CGM	11/01/99	APPROVED FOR CONSTRUCTION	CMI

RECORD OF REVISIONS

MATERIAL: ALUMINIUM, STAINLESS STEEL & PLASTICS

FINISH: HARD ANODISING & POWER PAINT COATINGS

USO, TOLERANCES TO BE

WT AIR - kg (E)	WT WATER - kg (E)
DRAWN	CGM
DATE	11/01/99
CHECK	MBI
APPRV.	RWR
ENGR.	CGM

sub-Atlantic
Unit 12, Airways Industrial Estate
Pitmedden Road, Dyce.
Aberdeen. U.K. AB21 0DT
Tel: ++44 (0) 1224 723623
Fax: ++44 (0) 1224 723822

SCALE (USO) 1 : 4

ORIG. SIZE A3

PROJECT: HYDRAULIC THRUSTERS

TITLE: SA-380 HYDRAULIC THRUSTER GENERAL ARRANGEMENT & INSTALLATION DRAWING

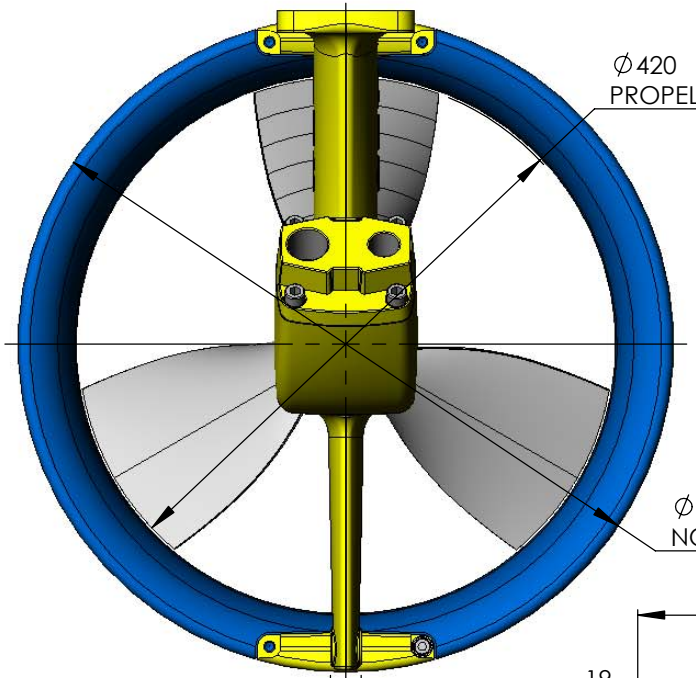
DOC. No. 0313-GA

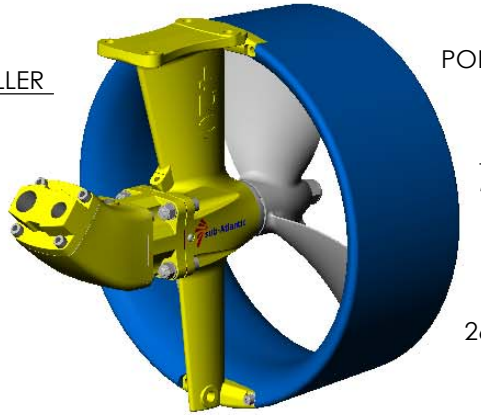
SHEET 1 of 1

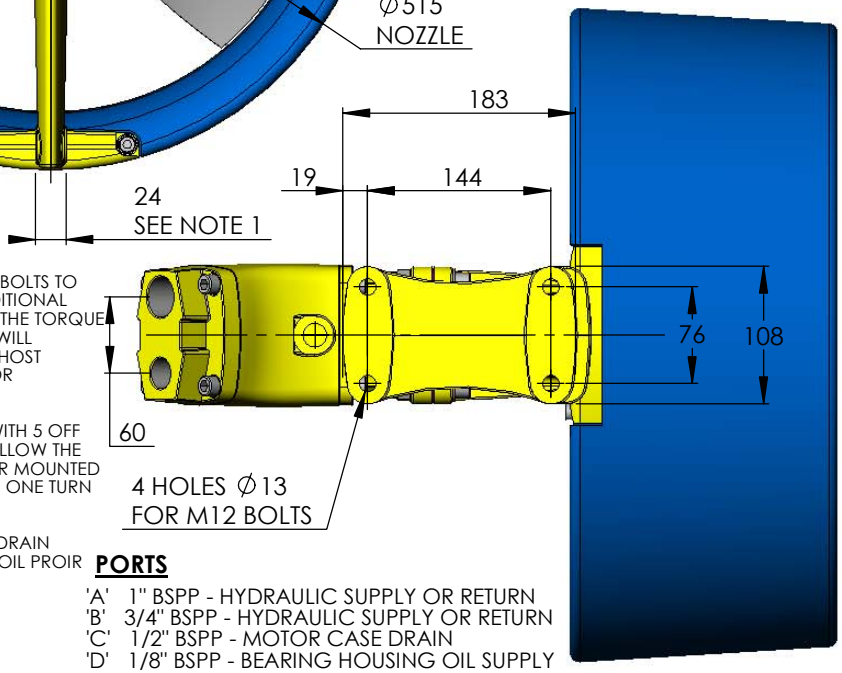
REV 2

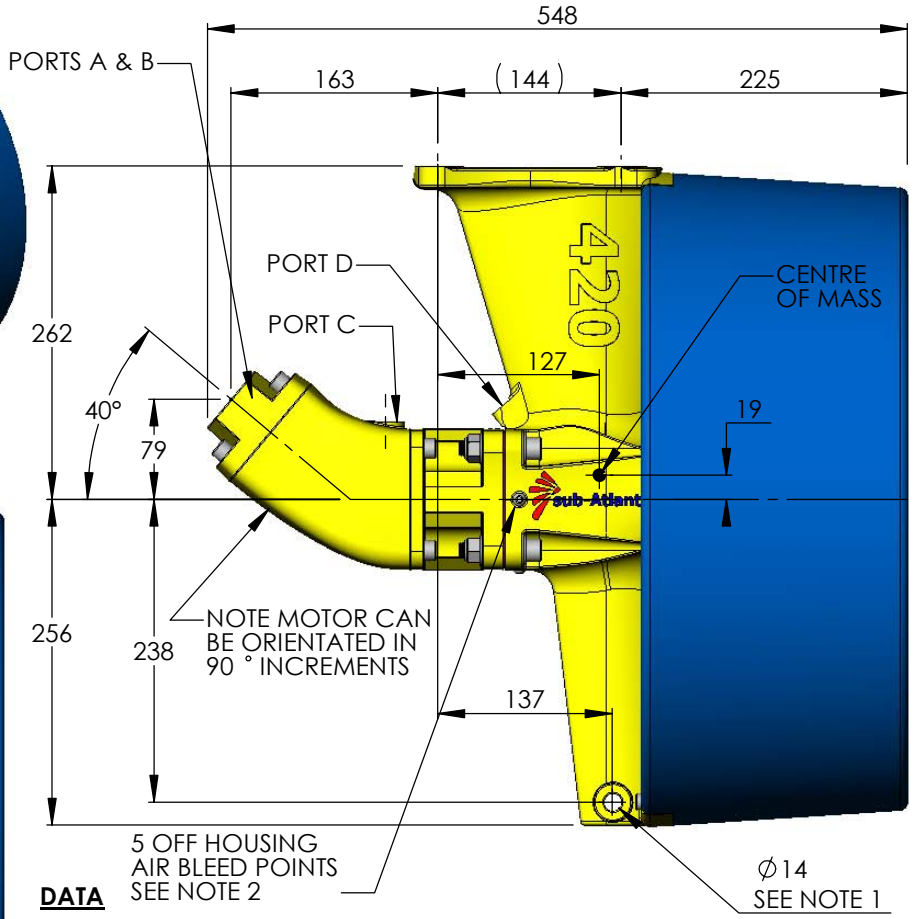
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF SUB-ATLANTIC LTD. ANY REPRODUCTION IN PART OR WHOLE WITHOUT THE WRITTEN PERMISSION OF SUB-ATLANTIC IS PROHIBITED
DUE TO OUR POLICY OF CONTINUAL PRODUCT DEVELOPMENT, SUB-ATLANTIC RESERVE THE RIGHT TO CHANGE THE INFORMATION CONTAINED IN THIS DRAWING WITHOUT PRIOR NOTICE.

THIRD ANGLE PROJECTION









NOTES

1. THRUSTER IS FIXED BY 4 OFF M12 BOLTS TO HOST STRUCTURE. IF REQUIRED ADDITIONAL M12 BOLT CAN BE FITTED THROUGH THE TORQUE RESTRAINT HOLE. USING THIS HOLE WILL ELIMINATE TORQUE EFFECTS TO THE HOST STRUCTURE BUT IS NOT REQUIRED FOR THRUSTER STRENGTH.

2. BEARING HOUSING IS SUPPIED WITH 5 OFF AIR BLEED POINTS POSITIONED TO ALLOW THE REMOVAL OF AIR WITH THE THRUSTER MOUNTED IN ANY ORIENTATION. TWIST SCREW ONE TURN TO BLEED AIR THEN TIGHTEN.

3. ENSURE THAT THE MOTOR CASE DRAIN PORT 'C' IS FILLED WITH HYDRAULIC OIL PROIR TO INITIAL START-UP AND SYSTEM COMMISSIONING.

PORTS

'A' 1" BSPP - HYDRAULIC SUPPLY OR RETURN
'B' 3/4" BSPP - HYDRAULIC SUPPLY OR RETURN
'C' 1/2" BSPP - MOTOR CASE DRAIN
'D' 1/8" BSPP - BEARING HOUSING OIL SUPPLY

DATA

WEIGHT IN AIR:	34 kG
WEIGHT IN SEA WATER:	17 kG
MAX. CONTINUOUS PRESSURE:	250 BAR (Higher Possible - Consult Tech. Dept.)
MAX. CONTINUOUS FLOW:	99 LPM
THRUST, PRESSURE, FLOW:	REFER TO DATA SHEET

OTHER SIZES AVAILABLE: SA-300, SA-380 & SA-500, SA-300-1002 INNERSPACE REPLACEMENTS & OTHER SPECIALS ASK FOR DATA SHEETS

REV	BY	DATE	DESCRIPTION	APP
3	EBR	6/09/02	INFORMATION UPDATED	CMI
2	CGM	26/01/99	MOUNTING DETAILS ALTERED	CMI
1	CGM	30/09/98	APPROVED FOR CONSTRUCTION	CMI

RECORD OF REVISIONS

MATERIAL: ALUMINIUM, STAINLESS STEEL & PLASTICS

FINISH: HARD ANODISING & POWER PAINT CAOTINGS

USO, TOLERANCES TO BE

WT AIR - kg (E)	WT WATER - kg (E)
DRAWN	CGM
DATE	30/09/98
CHECK	MBI
APPRV.	RWR
ENGR.	CGM

sub-Atlantic
Unit 12, Airways Industrial Estate
Pitmedden Road, Dyce.
Aberdeen. U.K. AB21 0DT
Tel: ++44 (0) 1224 723623
Fax: ++44 (0) 1224 723822

SCALE (USO) 1 : 4 | ORIG. SIZE A3

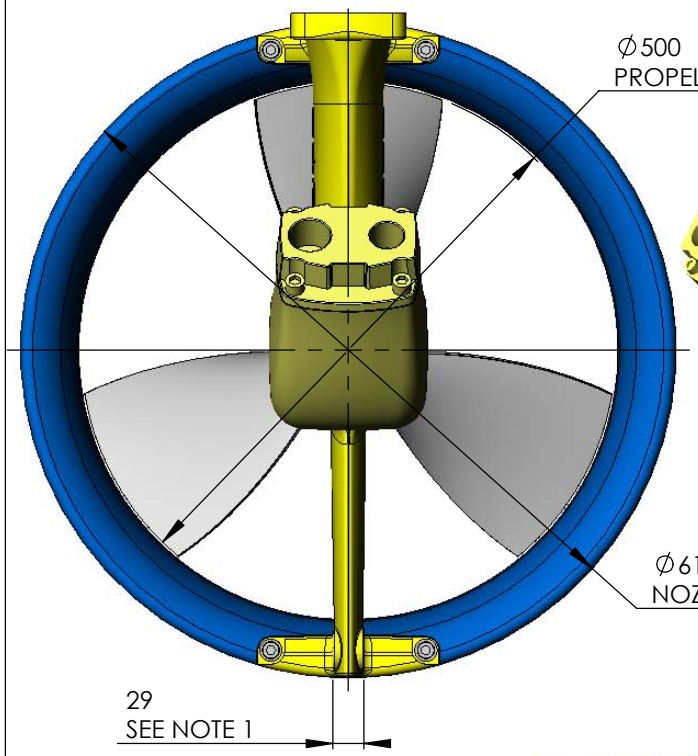
PROJECT: HYDRAULIC THRUSTERS

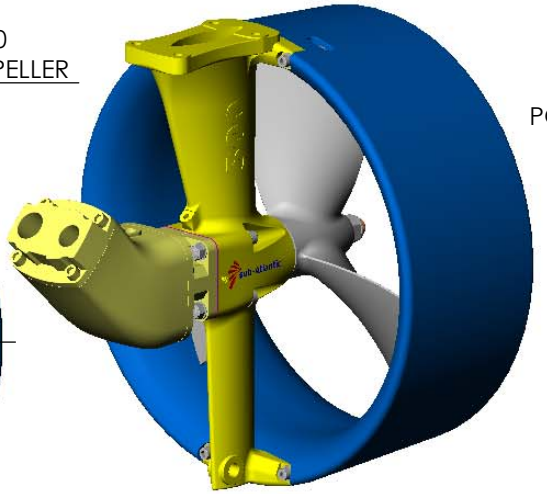
TITLE: SA-420 HYDRAULIC THRUSTER GENERAL ARRANGEMENT & INSTALLATION DRAWING

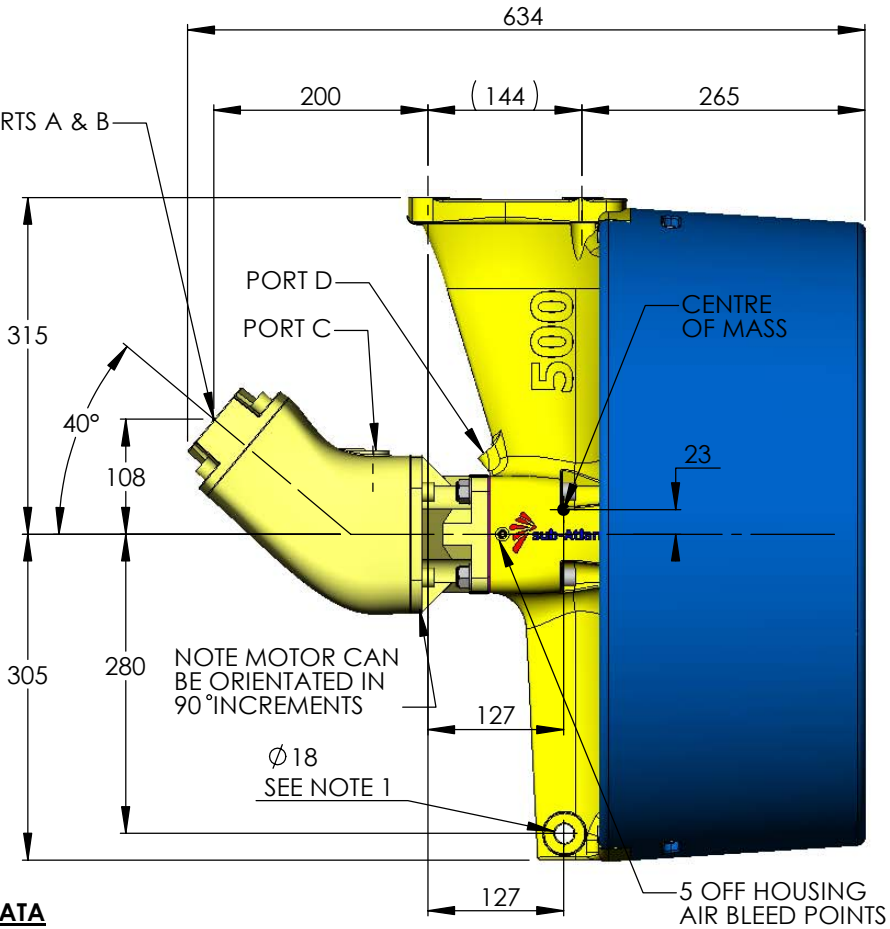
DOC. No. 0301-GA | SHEET 1 of 1 | REV 3

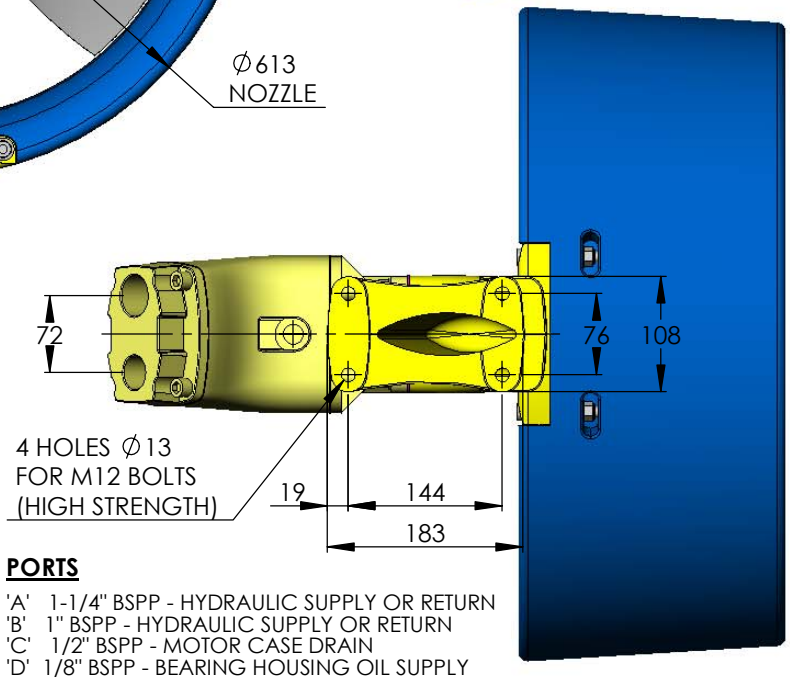
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF SUB-ATLANTIC LTD. ANY REPRODUCTION IN PART OR WHOLE WITHOUT THE WRITTEN PERMISSION OF SUB-ATLANTIC IS PROHIBITED
DUE TO OUR POLICY OF CONTINUAL PRODUCT DEVELOPMENT, SUB-ATLANTIC RESERVE THE RIGHT TO CHANGE THE INFORMATION CONTAINED IN THIS DRAWING WITHOUT PRIOR NOTICE.

THIRD ANGLE PROJECTION









NOTES

1. THRUSTER IS FIXED BY 4 OFF M12 BOLTS TO HOST STRUCTURE. IF REQUIRED ADDITIONAL M16 BOLT CAN BE FITTED THROUGH THE TORQUE RESTRAINT HOLE. USING THIS HOLE WILL ELIMINATE TORQUE EFFECTS TO THE HOST STRUCTURE BUT IS NOT REQUIRED FOR THRUSTER STRENGTH.

2. BEARING HOUSING IS SUPPIED WITH 5 OFF AIR BLEED POINTS POSITIONED TO ALLOW THE REMOVAL OF AIR WITH THE THRUSTER MOUNTED IN ANY ORIENTATION. TWIST SCREW ONE TURN TO BLEED AIR THEN TIGHTEN.

3. ENSURE THAT THE MOTOR CASE DRAIN PORT 'C' IS FILLED WITH HYDRAULIC OIL PROIR TO INITIAL START-UP AND SYSTEM COMMISSIONING.

PORTS

'A' 1-1/4" BSPP - HYDRAULIC SUPPLY OR RETURN
'B' 1" BSPP - HYDRAULIC SUPPLY OR RETURN
'C' 1/2" BSPP - MOTOR CASE DRAIN
'D' 1/8" BSPP - BEARING HOUSING OIL SUPPLY

DATA

WEIGHT IN AIR:	59 kG
WEIGHT IN SEA WATER:	31 kG
MAX. CONTINUOUS PRESSURE:	250 BAR (Higher Possible - Consult Tech. Dept.)
MAX. CONTINUOUS FLOW:	154 LPM
THRUST, PRESSURE, FLOW:	REFER TO DATA SHEET

OTHER THRUSTERS AVAILABLE: SA-300, SA-380 & SA-420.
SA-300-1002 INNERSPACE REPLACEMENTS & OTHER SPECIALS.
ASK FOR DATA SHEETS

REV	BY	DATE	DESCRIPTION	APP
2	EBR	13/09/02	NOTES UPDATED ECN-029-02	
1	CGM	08/10/99	PRELIMINARY FOR INFORMATION	CMI

RECORD OF REVISIONS

MATERIAL: ALUMINIUM, STAINLESS STEEL & PLASTICS

FINISH: HARD ANODISING & POWER PAINT CAOTINGS

USO, TOLERANCES TO BE

WT AIR	WT WATER
- kg (E)	- kg (E)

DRAWN	CGM
DATE	08/10/99
CHECK	MBI
APPRV.	RWR
ENGR.	CGM

sub-Atlantic
Unit 12, Airways Industrial Estate
Pitmedden Road, Dyce.
Aberdeen. U.K. AB21 0DT
Tel: ++44 (0) 1224 723623
Fax: ++44 (0) 1224 723822

SCALE (USO) 1 : 5 | ORIG. SIZE A3

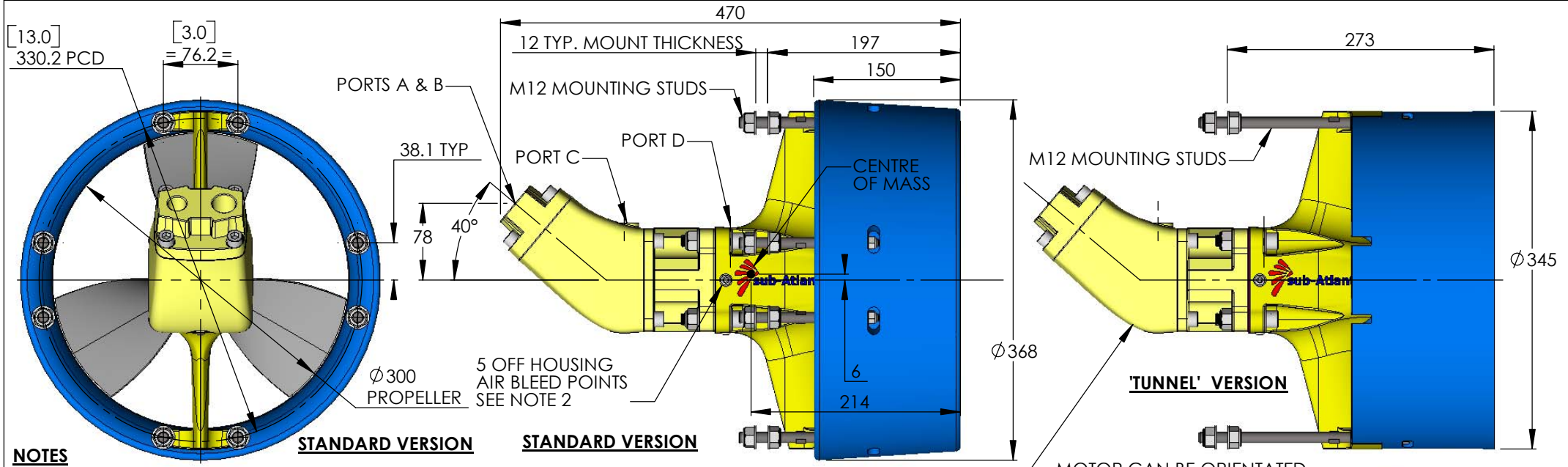
PROJECT: HYDRAULIC THRUSTERS

TITLE: SA-500 HYDRAULIC THRUSTER GENERAL ARRANGEMENT & INSTALLATION DRAWING

DOC. No. 0431-GA | SHEET 1 of 1 | REV 2

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF SUB-ATLANTIC LTD. ANY REPRODUCTION IN PART OR WHOLE WITHOUT THE WRITTEN PERMISSION OF SUB-ATLANTIC IS PROHIBITED

THIRD ANGLE PROJECTION



STANDARD VERSION

STANDARD VERSION

NOTES

1. THE THRUSTER IS AVAILABLE IN A STANDARD VERSION AND A 'TUNNEL VERSION. THE TUNNEL VERSION IS USED WHEN AVAILABLE SPACE IS LIMITED SUCH AS INSIDE SOME EXISTING BUOYANCY DESIGNS. THE ONLY DIFFERENCE BETWEEN THE TWO IS THE SYLE OF THE NOZZLE WHICH ARE INTERCHANGEABLE. THE THRUSTERS ARE FIXED BY 4 OR 8 OFF M12 STUDS WHICH PICK UP EXISTING INNERSPACE 1002 MOUNTING BRACKETS. STUDS CAN BE SUPPLIED IN DIFFERENT LENGTHS TO REPOSITION THE RELATIVE POSITION OF THE THRUSTER.

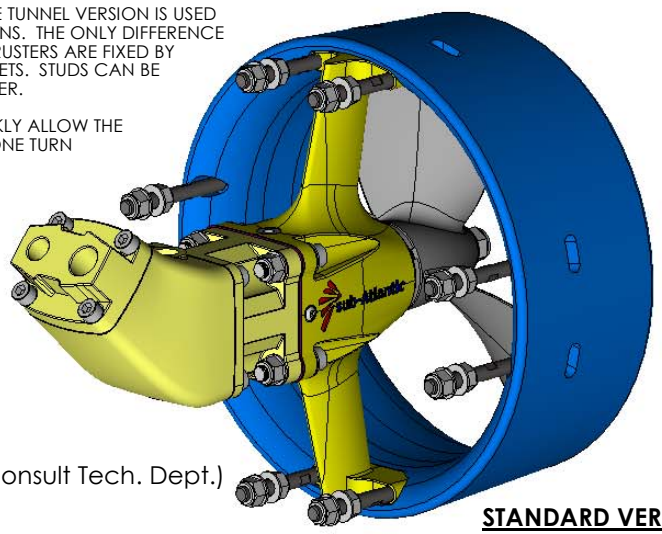
2. BEARING HOUSING IS SUPPIED WITH 5 OFF AIR BLEED POINTS POSITIONED TO QUICKLY ALLOW THE REMOVAL OF AIR WITH THE THRUSTER MOUNTED IN ANY ORIENTATION. TWIST SCREW ONE TURN TO BLEED AIR THEN TIGHTEN.

3. ENSURE THAT THE MOTOR CASE DRAIN PORT 'C' IS FILLED WITH HYDRAULIC OIL PROIR TO INITIAL START-UP AND SYSTEM COMMISSIONING.

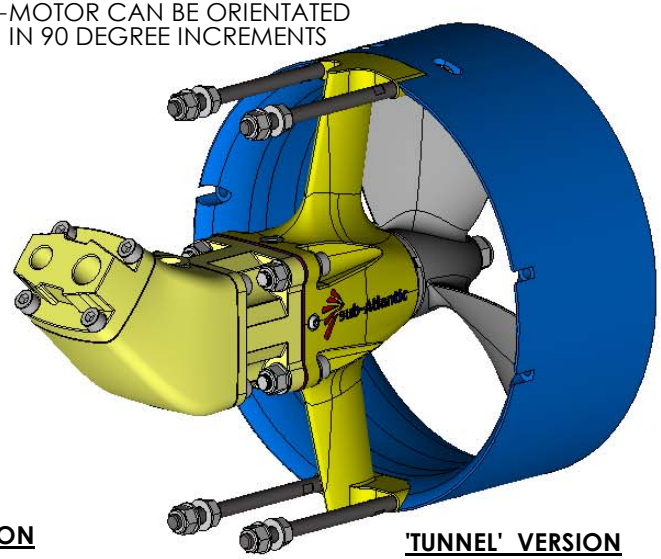
4. THRUSTER CAN BE SUPPLIED WITH EITHER 20cc OR 30cc MOTOR DEPENDING ON HYDRAULIC SYSTEM CAPABILITY (CONSULT SUB-ATLANTIC FOR SYSTEM ANALYSIS). 30 cc MOTOR SHOWN.

PORTS
'A' 1/2" BSPP - HYDRAULIC SUPPLY OR RETURN
'B' 3/4" BSPP - HYDRAULIC SUPPLY OR RETURN
'C' 1/2" BSPP - MOTOR CASE DRAIN
'D' 1/8" BSPP - BEARING HOUSING OIL SUPPLY

WEIGHT IN AIR:	18.4 kG
WEIGHT IN SEA WATER:	10.9 kG
MAX. CONTINUOUS PRESSURE:	250 BAR (Higher Possible - Consult Tech. Dept.)
MAX. CONTINUOUS FLOW:	56 LPM
THRUST, PRESSURE, FLOW:	REFER TO DATA SHEET



STANDARD VERSION



'TUNNEL' VERSION

REV	BY	DATE	DESCRIPTION	APP
1	EBR	4/09/02	ISSUED FOR CONSTRUCTION	CMI
A	CMI	22/11/01	ISSUED FOR APPROVAL	CMI

RECORD OF REVISIONS

MATERIAL
ALUMINIUM, STAINLESS STEEL & PLASTICS

FINISH
HARD ANODISING & POWER PAINT COATINGS

USO, TOLERANCES TO BE

WT AIR - kg (E)	WT WATER - kg (E)
DRAWN	CMI
DATE	22/11/01
CHECK	MBI
APPRV.	CMI
ENGR.	CMI

sub-Atlantic
Unit 12, Airways Industrial Estate
Pitmedden Road, Dyce.
Aberdeen. U.K. AB21 0DT
Tel: ++44 (0) 1224 723623
Fax: ++44 (0) 1224 723822

SCALE (USO) 1 : 4

ORIG. SIZE A3

PROJECT HYDRAULIC THRUSTERS

TITLE
SA-300-1002 HYD. THRUSTER GENERAL ARRANGEMENT & INSTALLATION DRAWING

DOC. No. 1412-GA

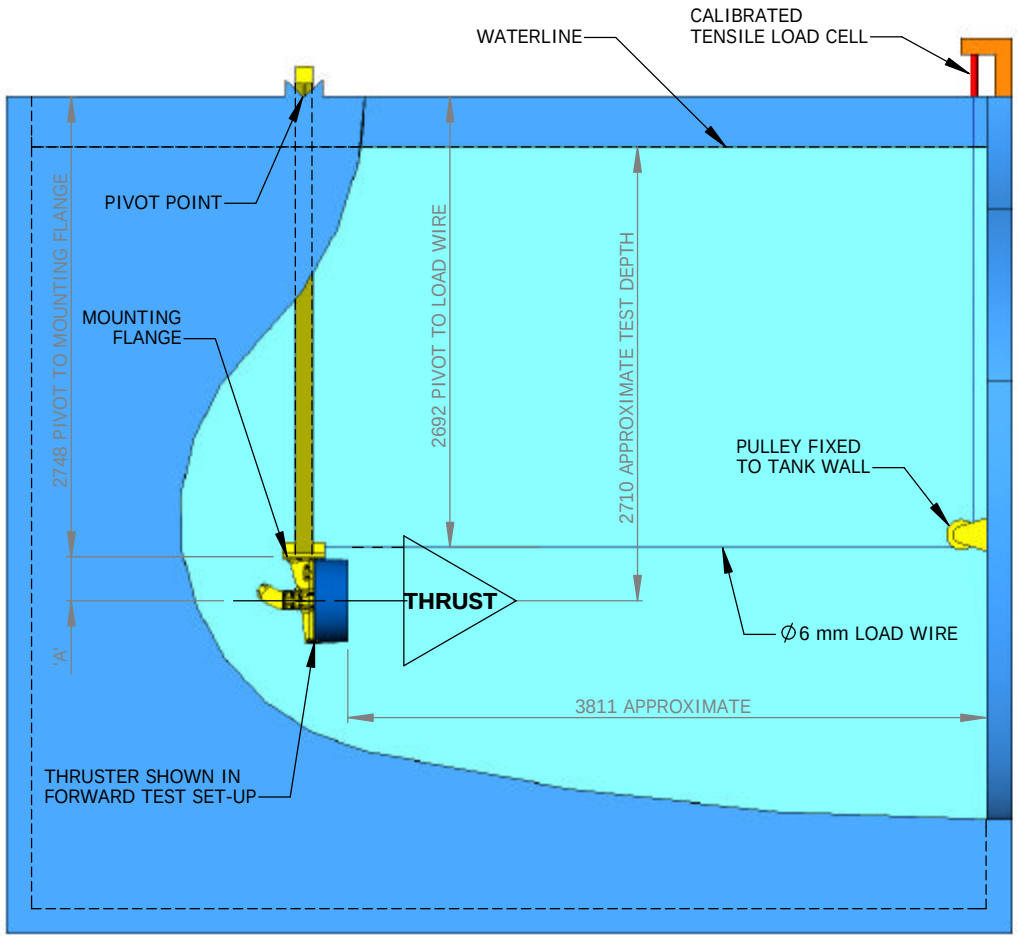
SHEET 1 of 1

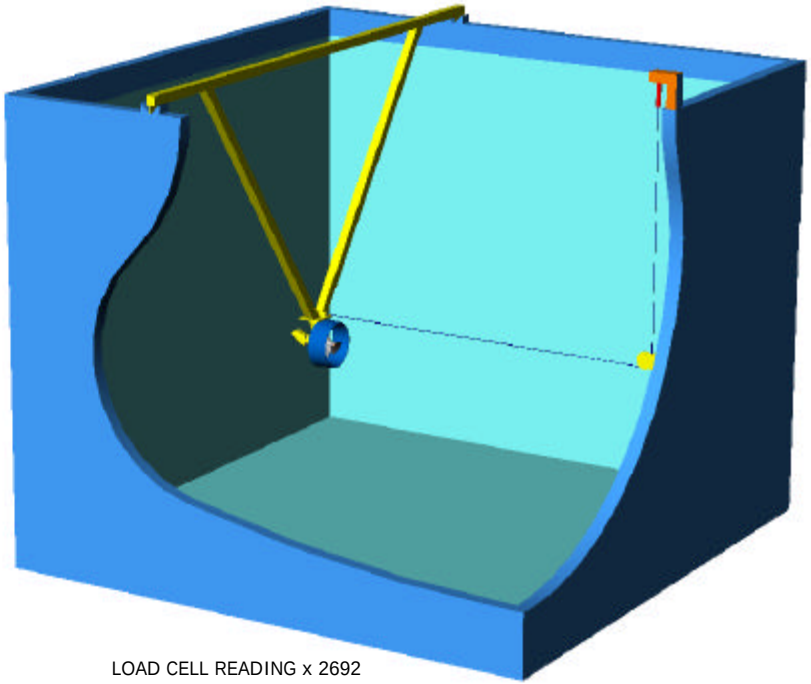
REV 1

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF SUB-ATLANTIC LTD. ANY REPRODUCTION IN PART OR WHOLE WITHOUT THE WRITTEN PERMISSION OF SUB-ATLANTIC IS PROHIBITED

THIRD ANGLE PROJECTION

IF IN DOUBT - ASK!





$$\text{BOLLARD THRUST} = \frac{\text{LOAD CELL READING} \times 2692}{(\ 2748 + \text{'A'}\ )}$$

PRESSURE IS RECORDED DIRECTLY AT MOTOR INLET AND OUTLET ON CALIBRATED PRESSURE GAUGES. TEST PRESSURE = INLET PRESSURE MINUS OUTLET PRESSURE.

MOTOR INLET FLOW IS RECORDED ON CALIBRATED FLOW METER.

OIL TEMPERATURE IS RECORDED FROM FLOWMETER.

CASE DRAINAGE IS RECORDED AT 200 BAR.

OUTLINE TEST PROCEDURE (FORWARD & REVERSE TESTS)
1. SET FLOW RATE AT 5 LPM, SWITCH OFF FLOW AND ALLOW WATER IN TANK TO SETTLE, SWITCH ON FLOW, RECORD INLET & OUTLET PRESSURES, LOAD CELL & FLOW RATE.
2. SET FLOW RATE AT NEXT INCREMENT (e.g. 7.5 LPM), SWITCH OFF FLOW AND ALLOW WATER TO SETTLE, SWITCH ON FLOW AND TAKE NEXT SET OF READINGS.
3. REPEAT AS ABOVE FOR FLOW INCREMENT STEPS UNTIL THE MAXIMUM MOTOR PRESSURE IS REACHED.
4. REMOVE TEST FRAME, REVERSE THRUSTER ON FRAME, RELACE IN TANK AND CARRY OUT TESTS AS ABOVE TO CHECK REVERSE BOLLARD THRUST.

REV	BY	DATE	DESCRIPTION	APP
-	-	-	-	
1	CMI	28/01/99	APPROVED FOR CONSTRUCTION	

RECORD OF REVISIONS

MATERIAL -

FINISH -

USO, TOLERANCES TO BE -

WT AIR	WT WATER
- kg (E)	- kg (E)

DRAWN	CMI
DATE	28/01/99
CHECK	MBI
APPRV.	RWR
ENGR.	RWR

sub-Atlantic
Unit 12, Airways Industrial Estate
Pitmedden Road, Dyce.
Aberdeen. U.K. AB21 0DT
Tel: ++44 (0) 1224 723623
Fax: ++44 (0) 1224 723822

SCALE (USO) 1 : 30 | ORIG. SIZE A3

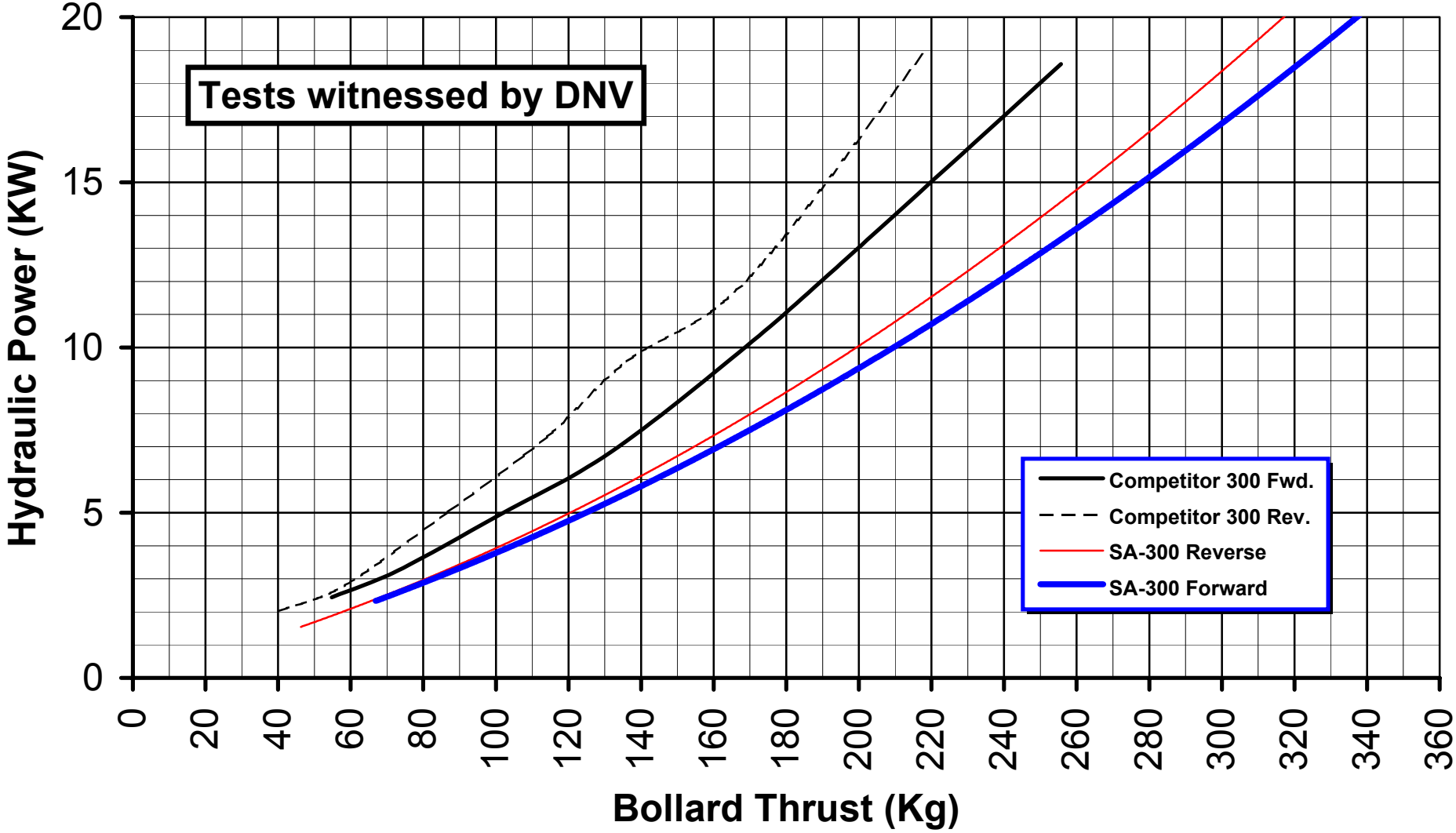
PROJECT HYDRAULIC THRUSTERS

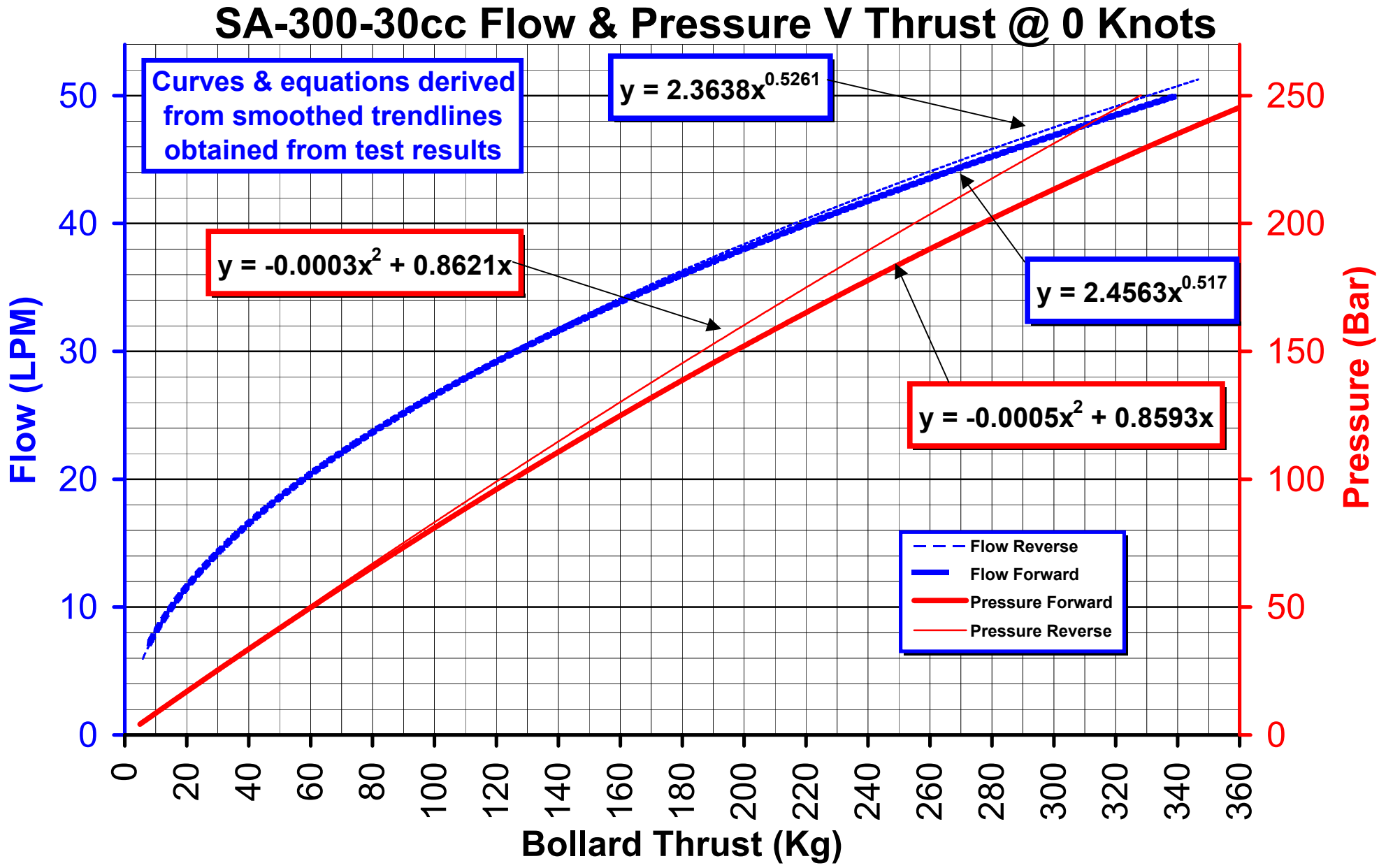
TITLE THRUSTER TEST RIG GENERAL ARRANGEMENT Sheet 1 of 1

DOC. No. 0438-GA | REV 1

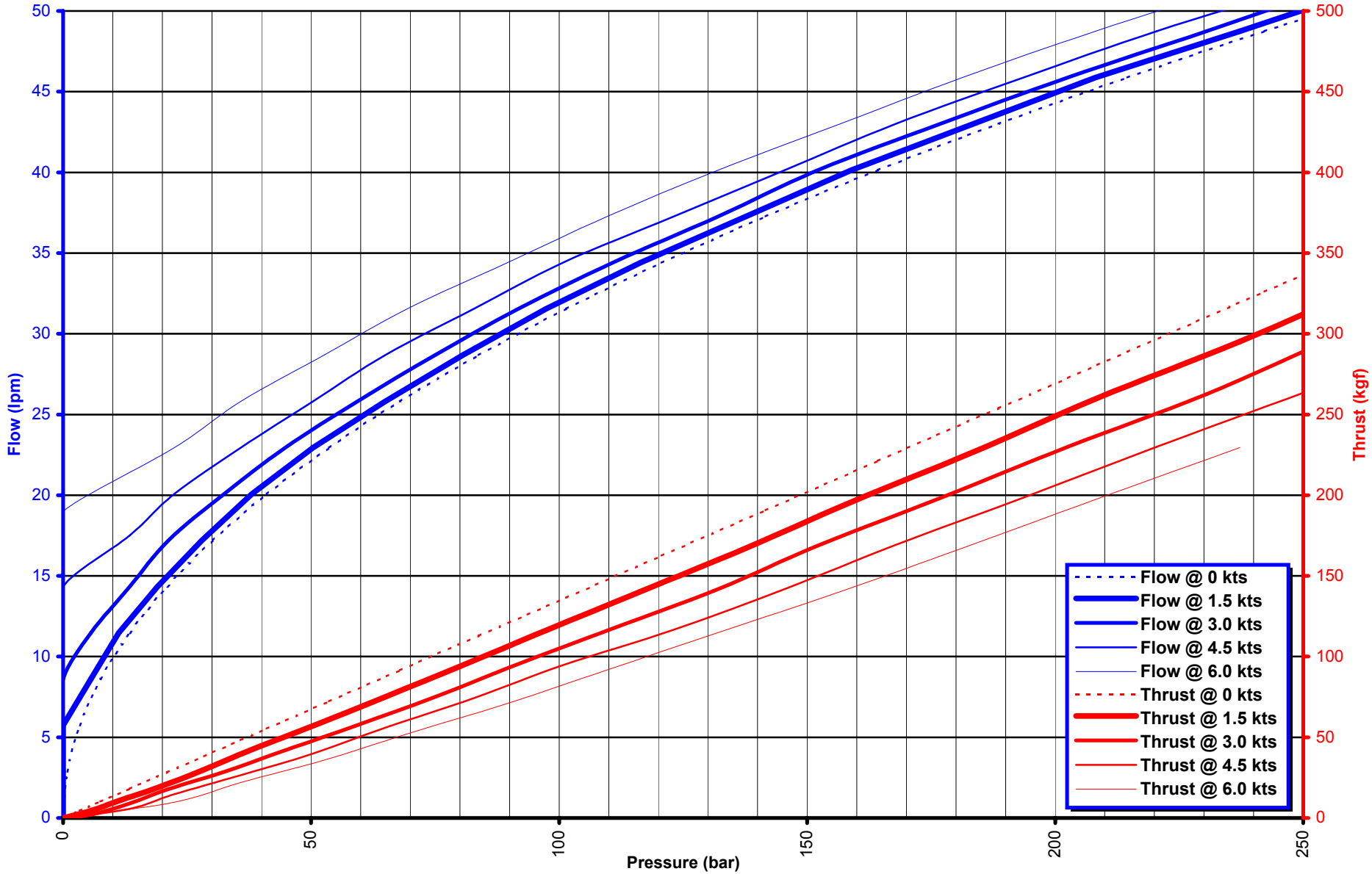
SA-300 Hydraulic Power Vs Thrust

(Competitor comparitive also shown)




SA-300-30cc Flow & Pressure V Thrust @ 0 Knots
Curves & equations derived from smoothed trendlines obtained from test results
y = 2.3638x^0.5261
y = -0.0003x^2 + 0.8621x
y = 2.4563x^0.517
y = -0.0005x^2 + 0.8593x
Flow Reverse
Flow Forward
Pressure Forward
Pressure Reverse
Flow (LPM)
Pressure (Bar)
Bollard Thrust (Kg)
0
10
20
30
40
50
0
50
100
150
200
250
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360

SA-300-30cc-SF Flow & Thrust V Pressure at Various Advance Speeds

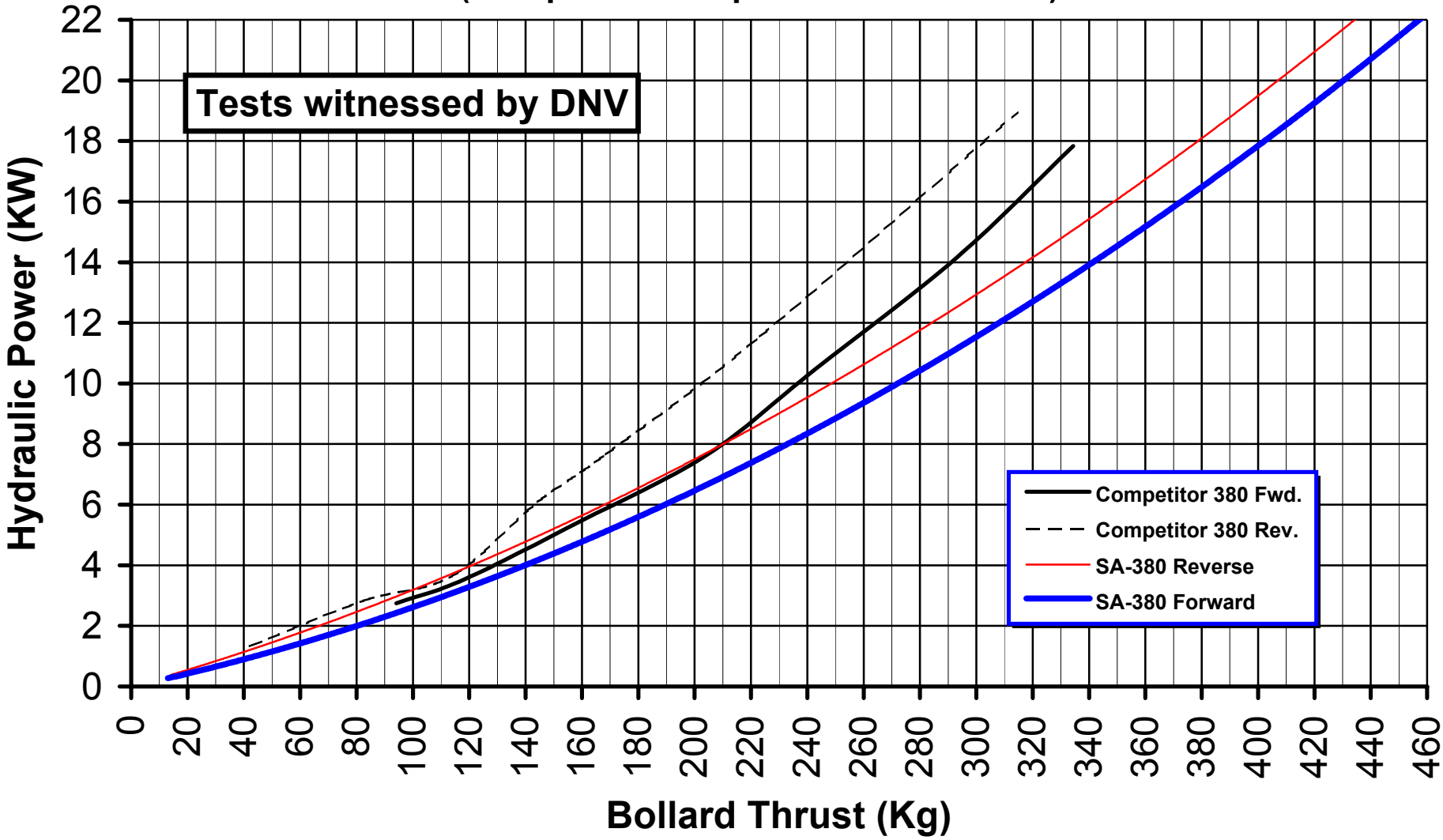


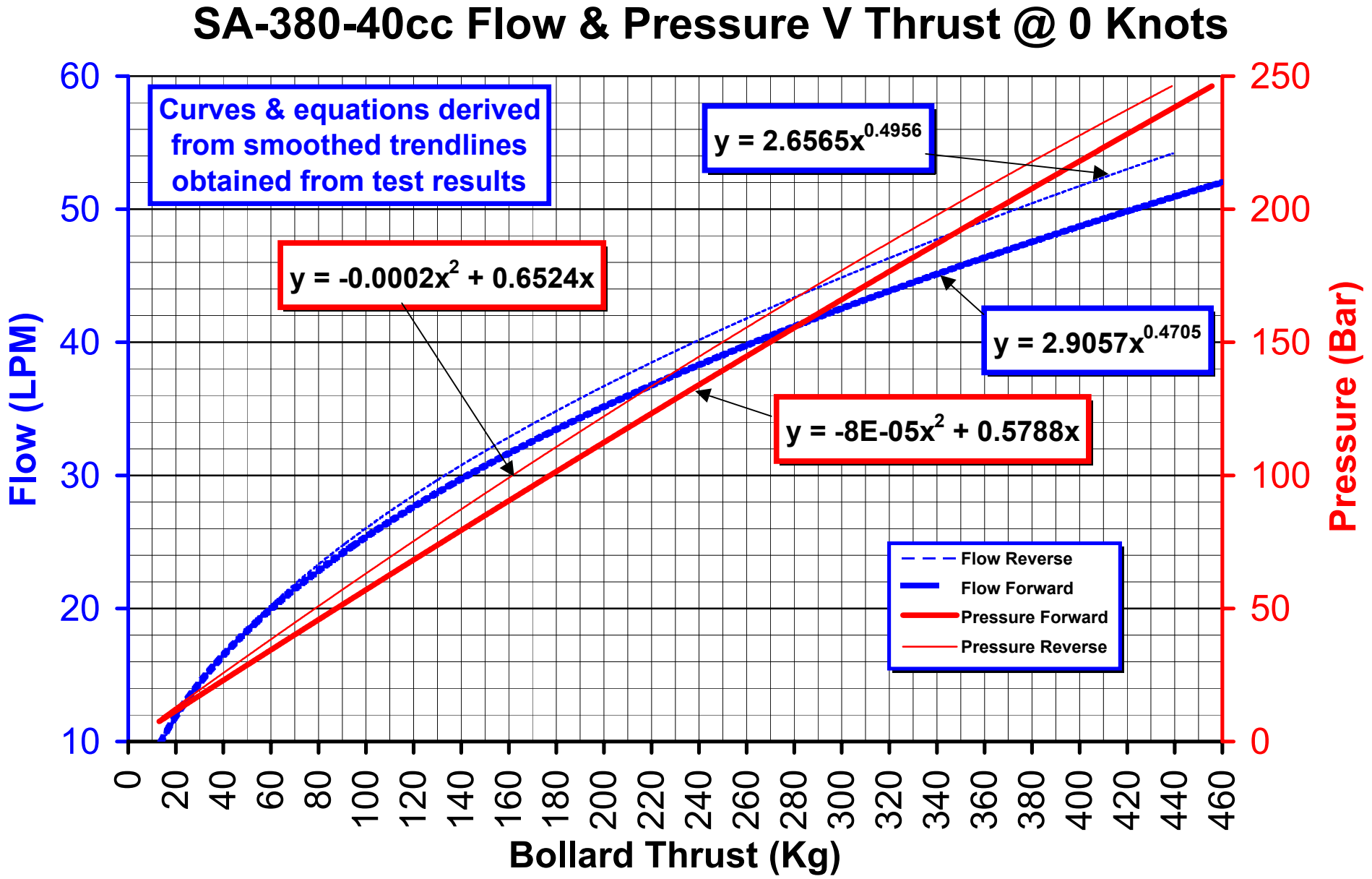
Copies of Certified DNV data sheets available

Curves & equations derived from DNV witnessed bollard test results

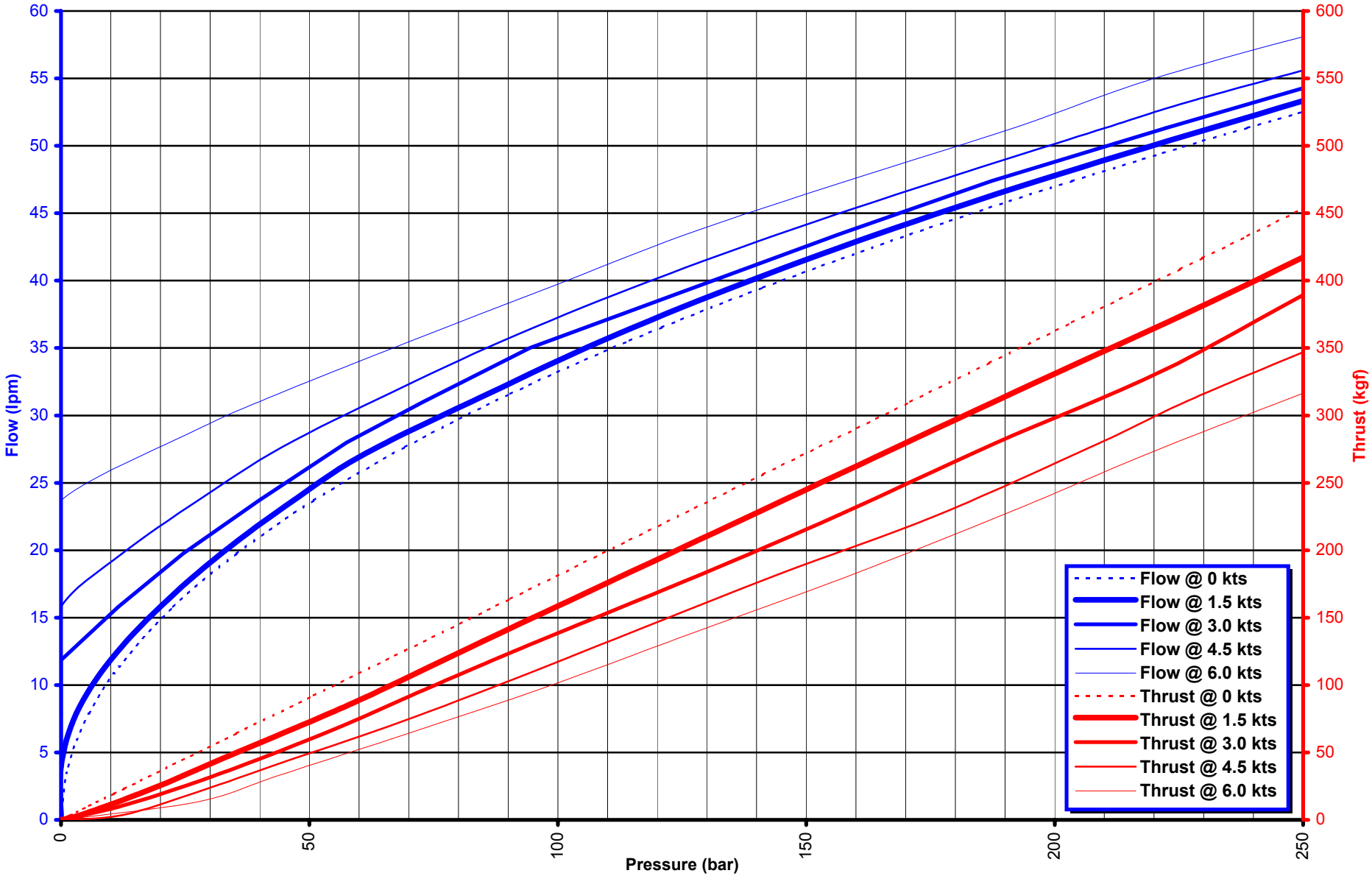
SA-380 Hydraulic Power Vs Thrust

(Competitor comparitive also shown)




SA-380-40cc Flow & Pressure V Thrust @ 0 Knots
Curves & equations derived from smoothed trendlines obtained from test results
y = 2.6565x^0.4956
y = -0.0002x^2 + 0.6524x
y = 2.9057x^0.4705
y = -8E-05x^2 + 0.5788x
Flow Reverse
Flow Forward
Pressure Forward
Pressure Reverse
Flow (LPM)
Pressure (Bar)
Bollard Thrust (Kg)
60
50
40
30
20
10
250
200
150
100
50
0
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
460

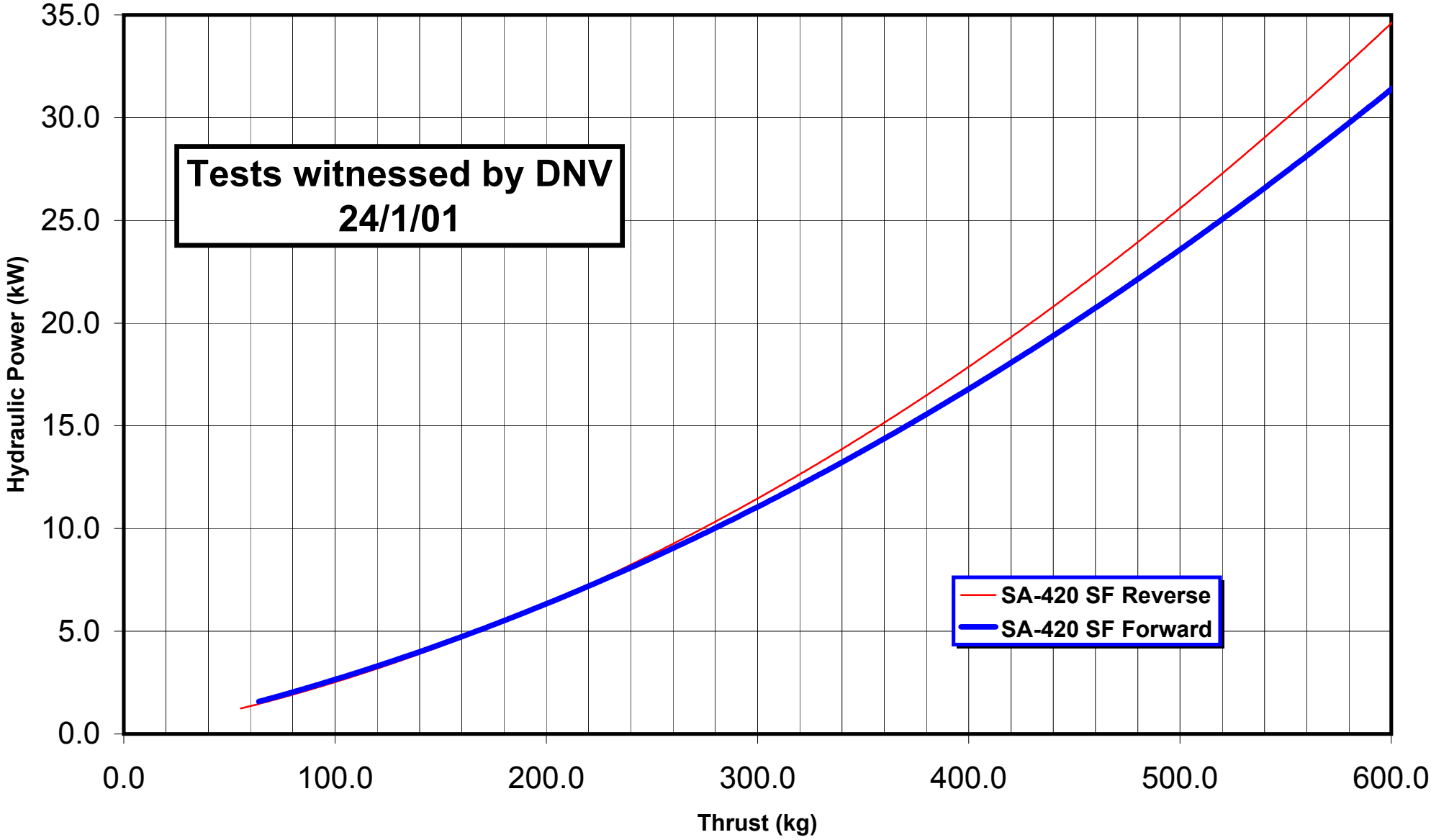
SA-380-40cc-SF Flow & Thrust V Pressure at Various Advance Speeds

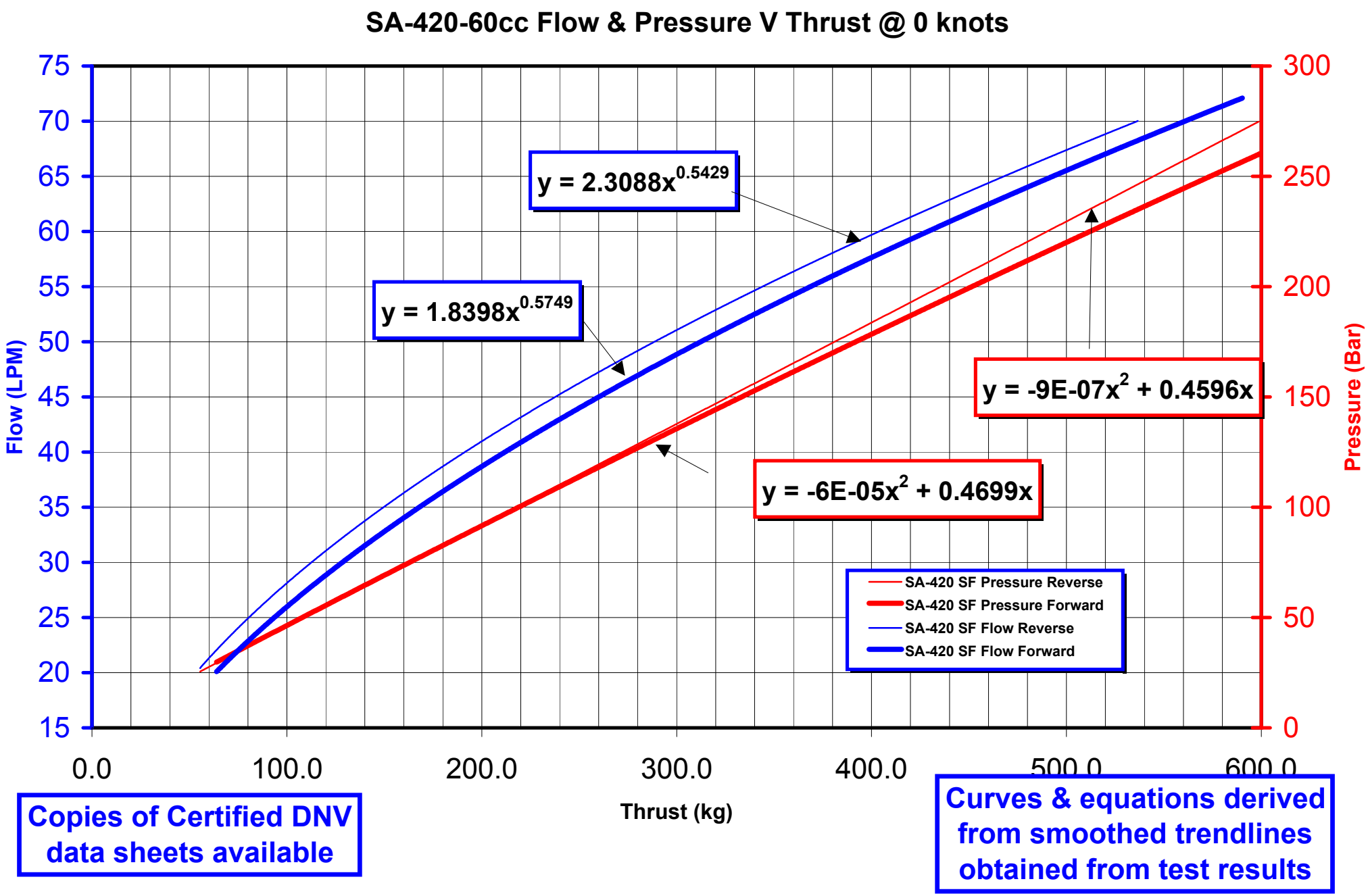


Copies of Certified DNV data sheets available

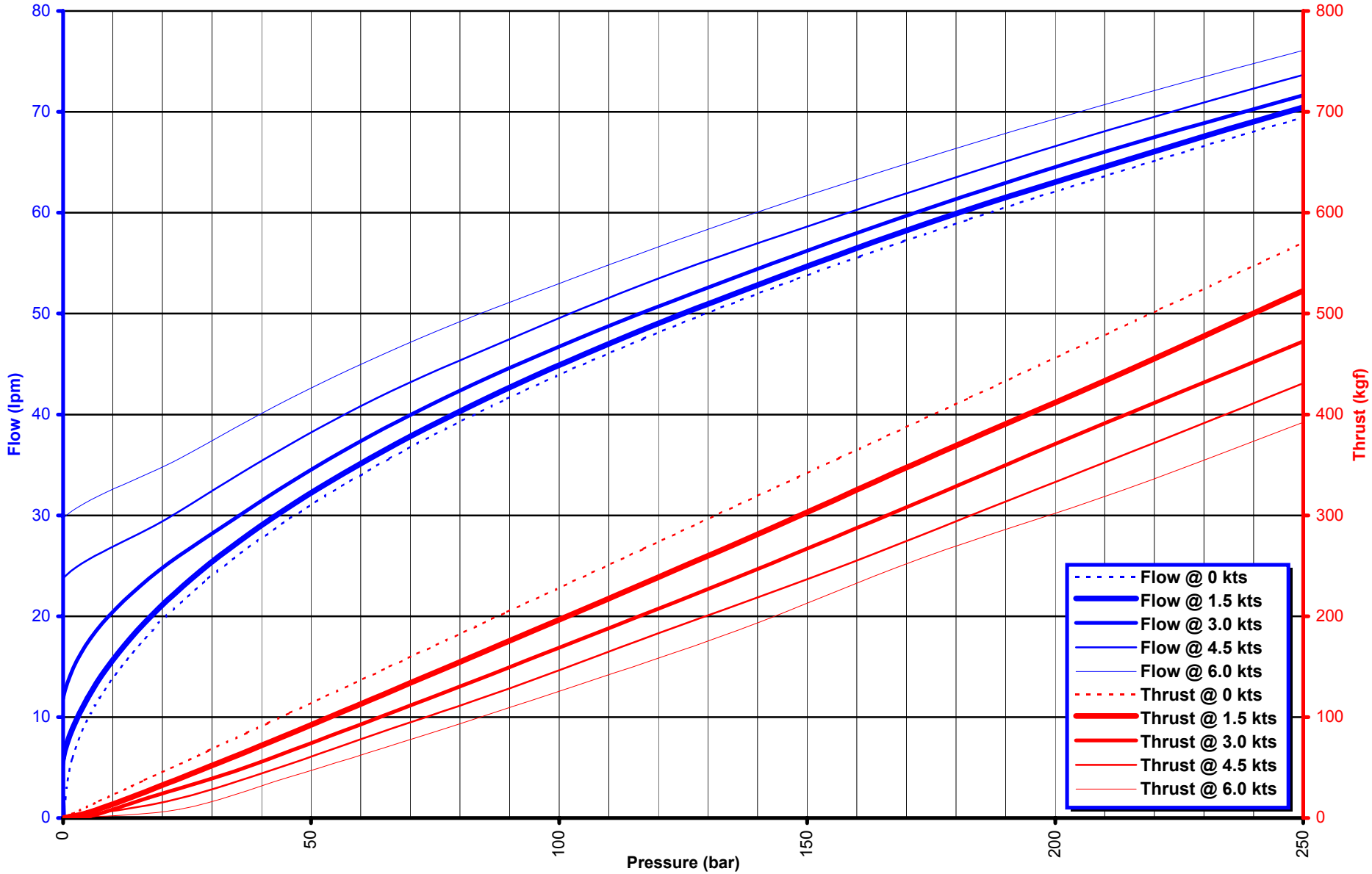
Curves & equations derived from DNV witnessed bollard test results

SA-420 SF Hydraulic Power Vs Thrust @ 0 knots



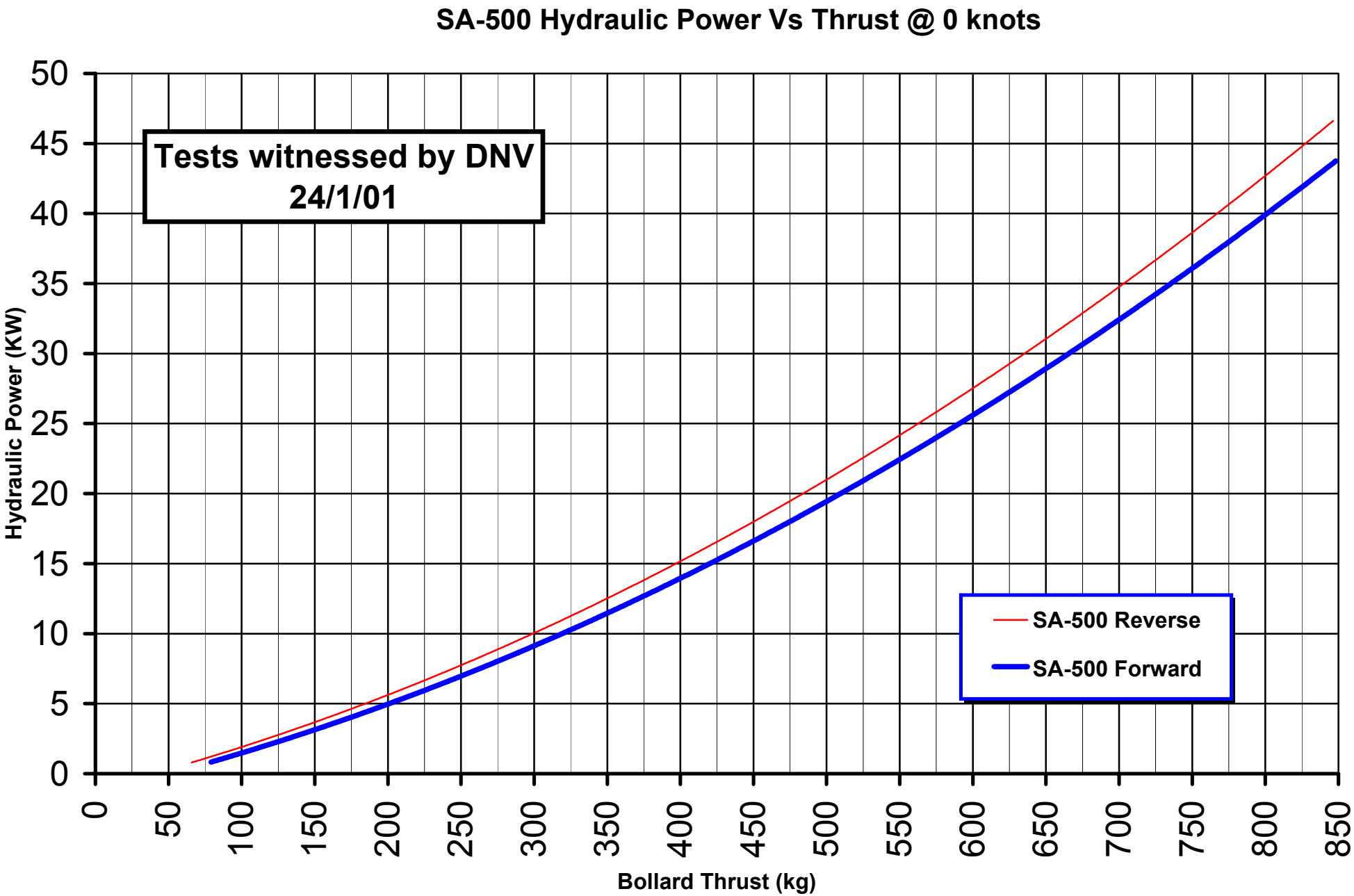

SA-420-60cc Flow & Pressure V Thrust @ 0 knots
Flow (LPM)
Pressure (Bar)
Thrust (kg)
75
70
65
60
55
50
45
40
35
30
25
20
15
300
250
200
150
100
50
0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
y = 2.3088x^0.5429
y = 1.8398x^0.5749
y = -9E-07x^2 + 0.4596x
y = -6E-05x^2 + 0.4699x
SA-420 SF Pressure Reverse
SA-420 SF Pressure Forward
SA-420 SF Flow Reverse
SA-420 SF Flow Forward
Copies of Certified DNV data sheets available
Curves & equations derived from smoothed trendlines obtained from test results

SA-420-60cc-SF Flow & Thrust V Pressure at Various Advance Speeds

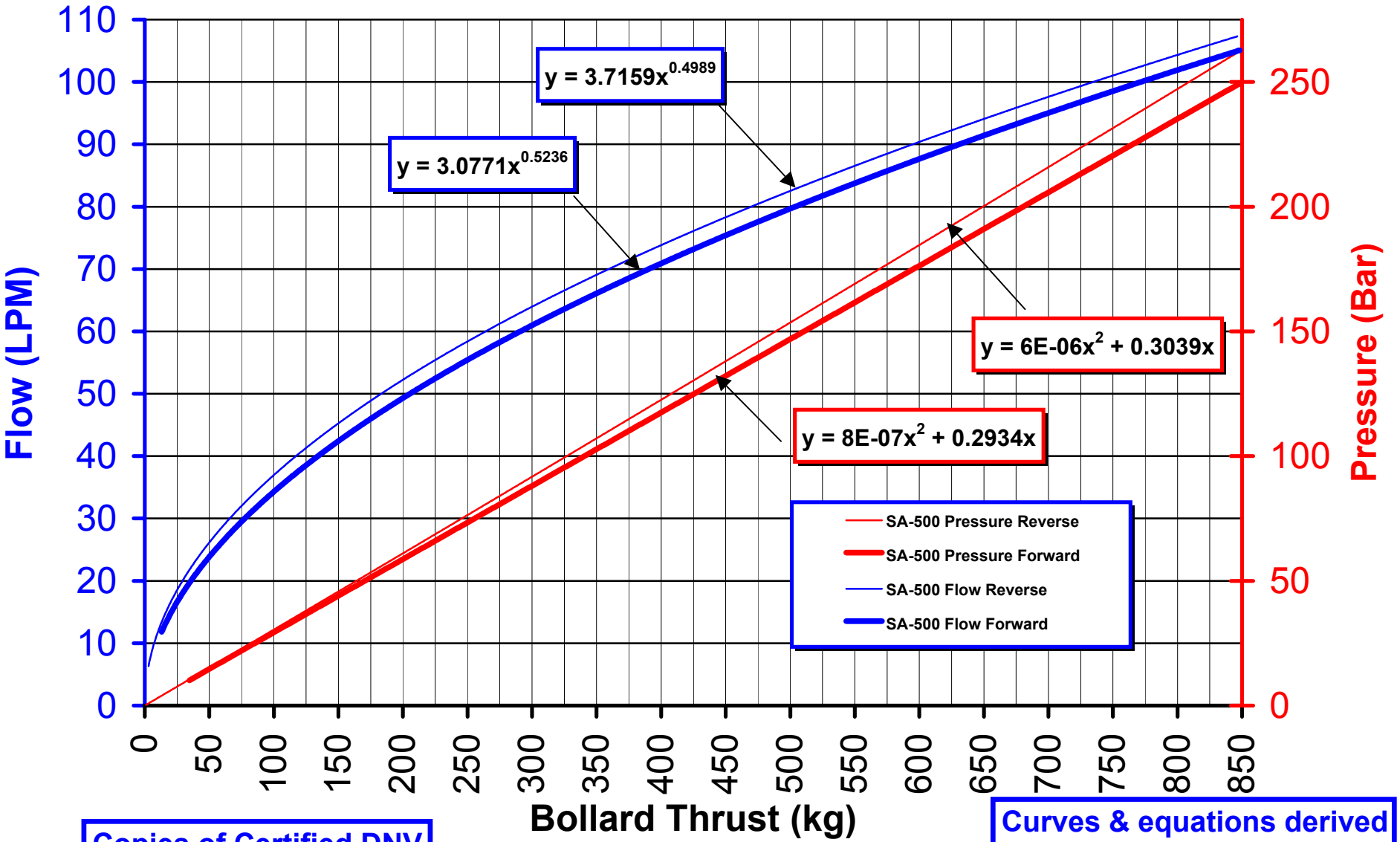


Copies of Certified DNV data sheets available

Curves & equations derived from DNV witnessed bollard test results


SA-500 Hydraulic Power Vs Thrust @ 0 knots
Tests witnessed by DNV
24/1/01
Hydraulic Power (KW)
0
5
10
15
20
25
30
35
40
45
50
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
Bollard Thrust (kg)
SA-500 Reverse
SA-500 Forward

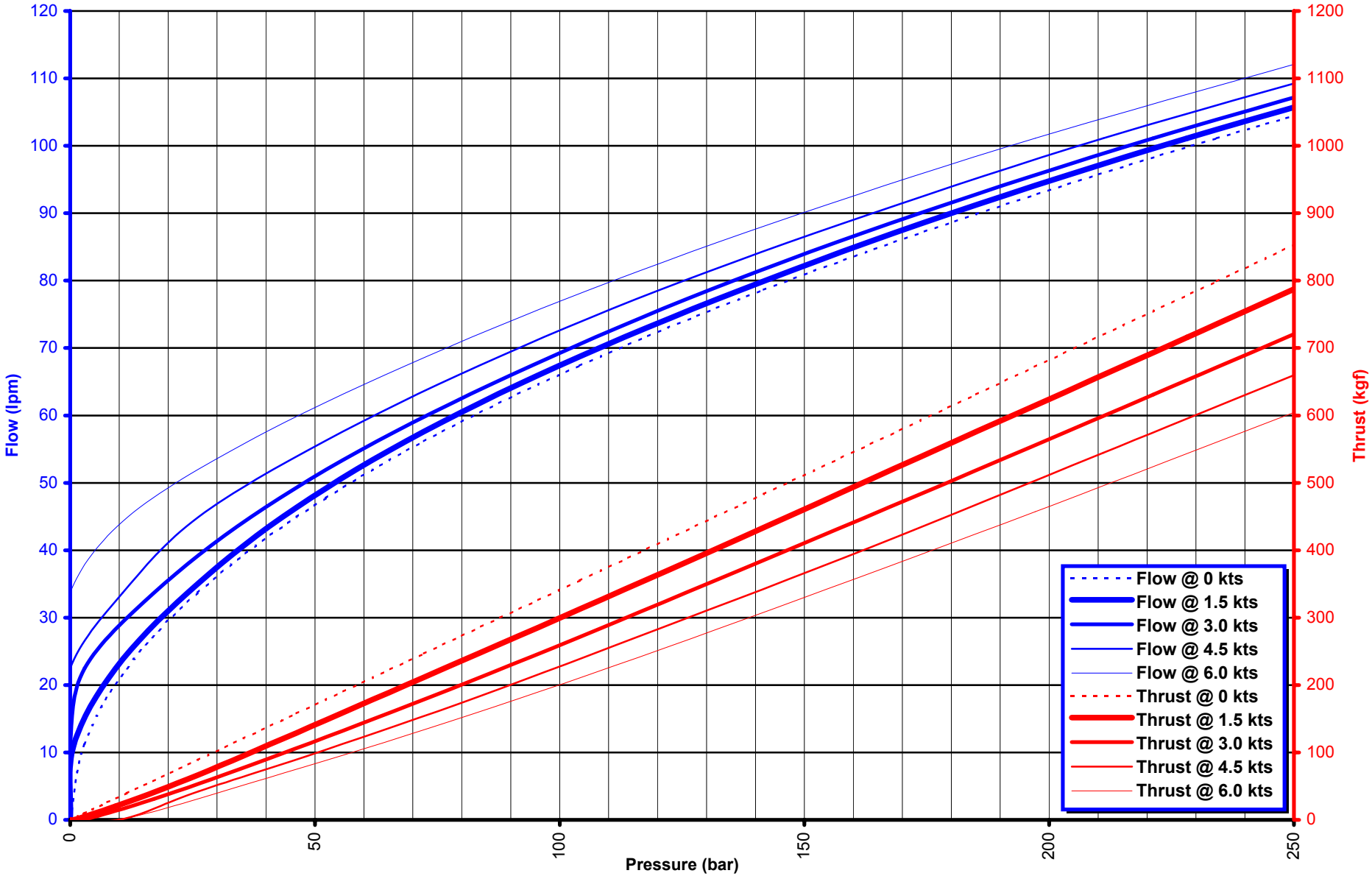
SA-500-110cc Flow & Pressure V Thrust @ 0 knots



Copies of Certified DNV data sheets available

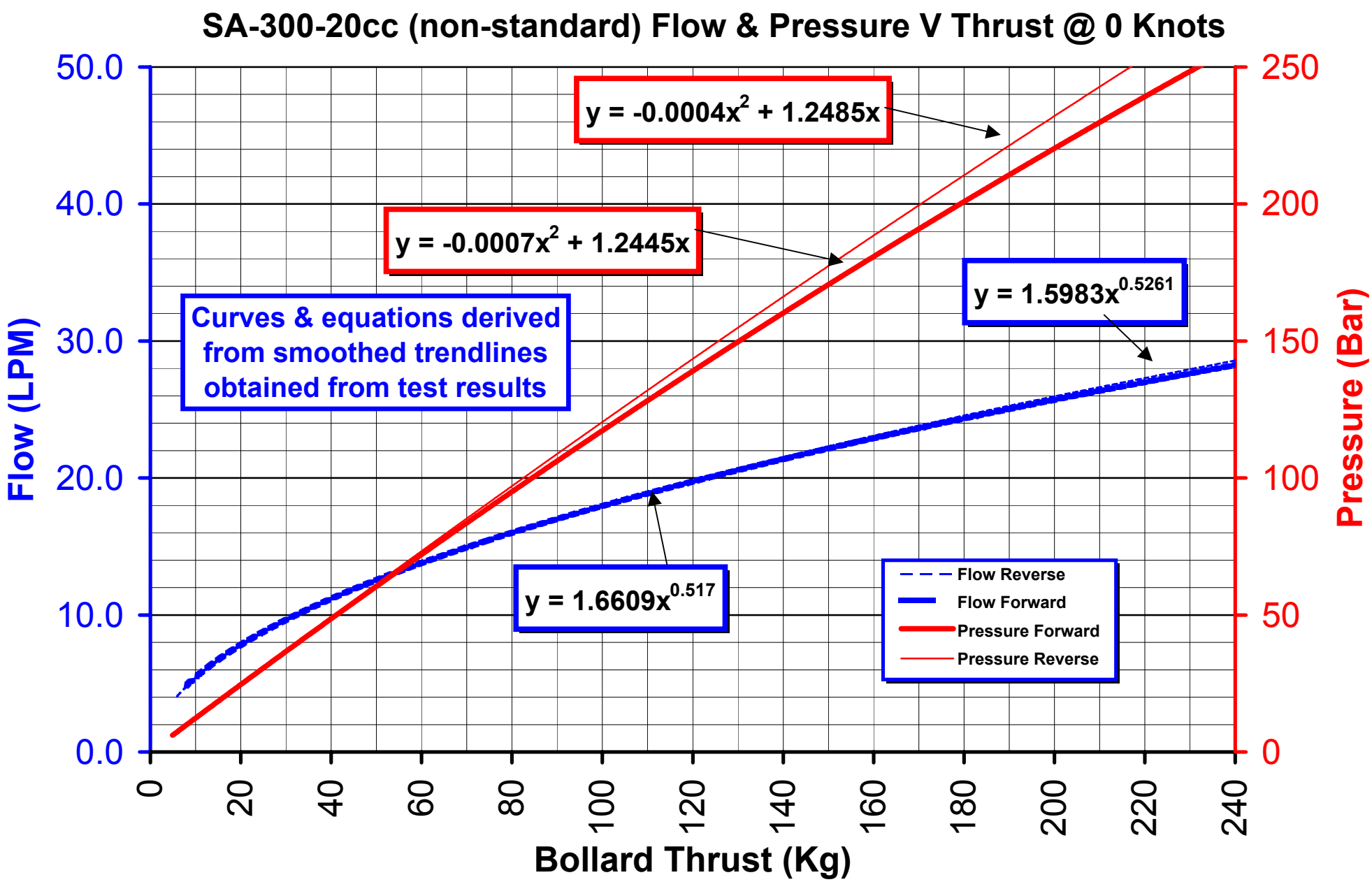
Curves & equations derived from smoothed trendlines obtained from test results

SA-500-110cc-SF Flow & Thrust V Pressure at Various Advance Speeds

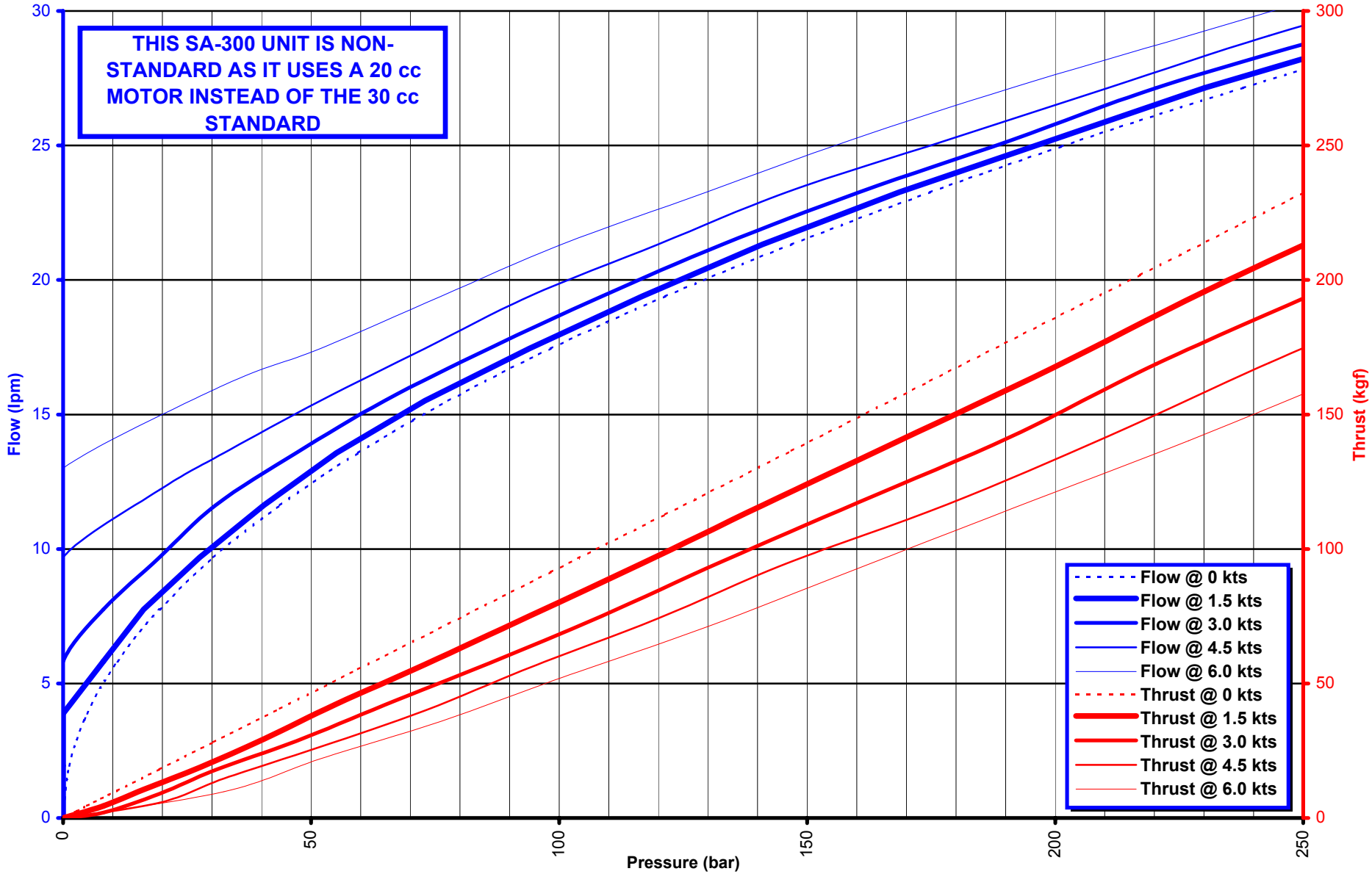


Copies of Certified DNV data sheets available

Curves & equations derived from DNV witnessed bollard test results

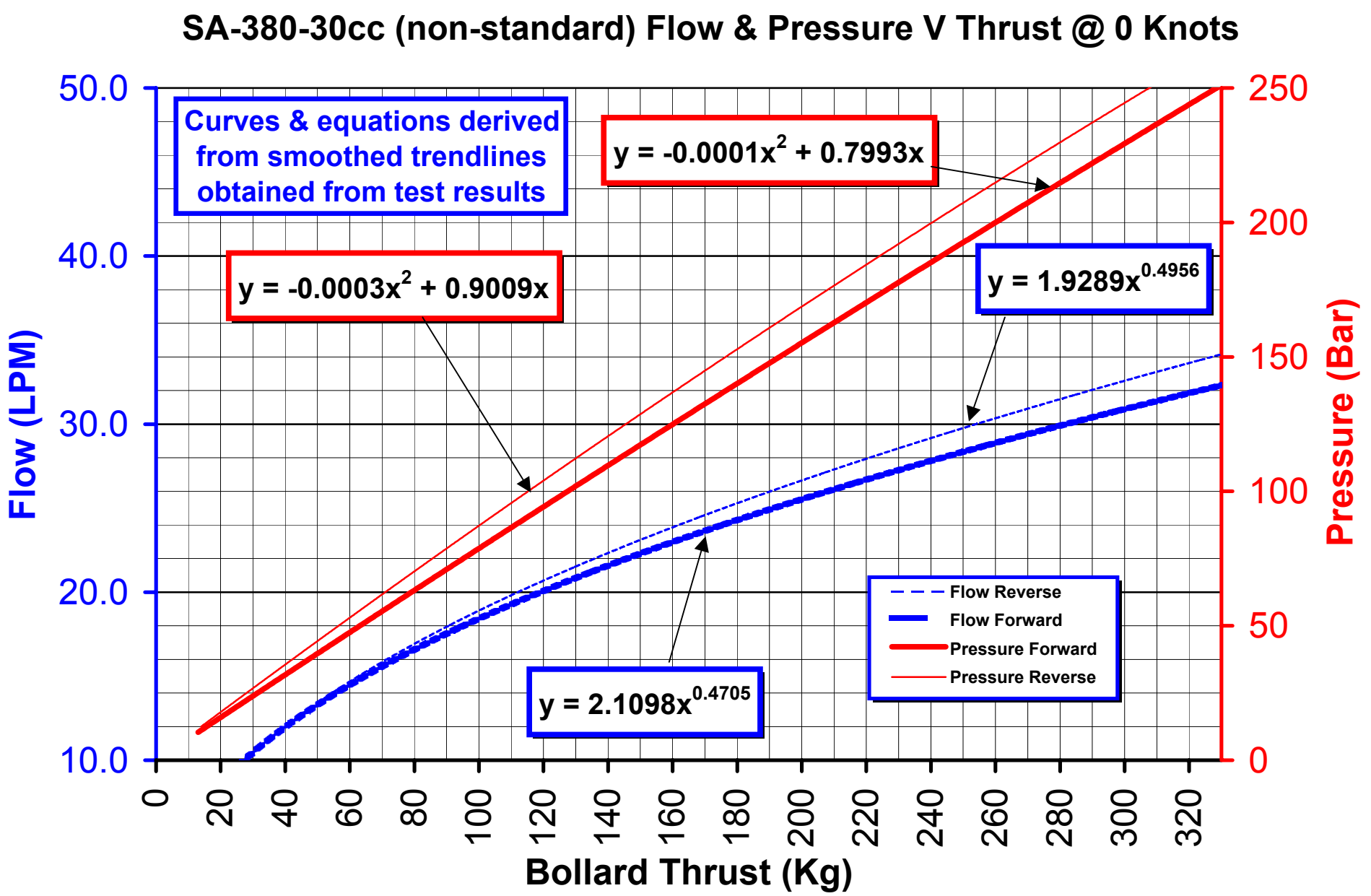

SA-300-20cc (non-standard) Flow & Pressure V Thrust @ 0 Knots
y = -0.0004x2 + 1.2485x
y = -0.0007x2 + 1.2445x
y = 1.5983x0.5261
y = 1.6609x0.517
Curves & equations derived from smoothed trendlines obtained from test results
Flow Reverse
Flow Forward
Pressure Forward
Pressure Reverse
Flow (LPM)
Pressure (Bar)
Bollard Thrust (Kg)
0.0
10.0
20.0
30.0
40.0
50.0
0
50
100
150
200
250
0
20
40
60
80
100
120
140
160
180
200
220
240

SA-300-20cc-SF (non-standard) Flow & Thrust V Pressure at Various Advance Speeds

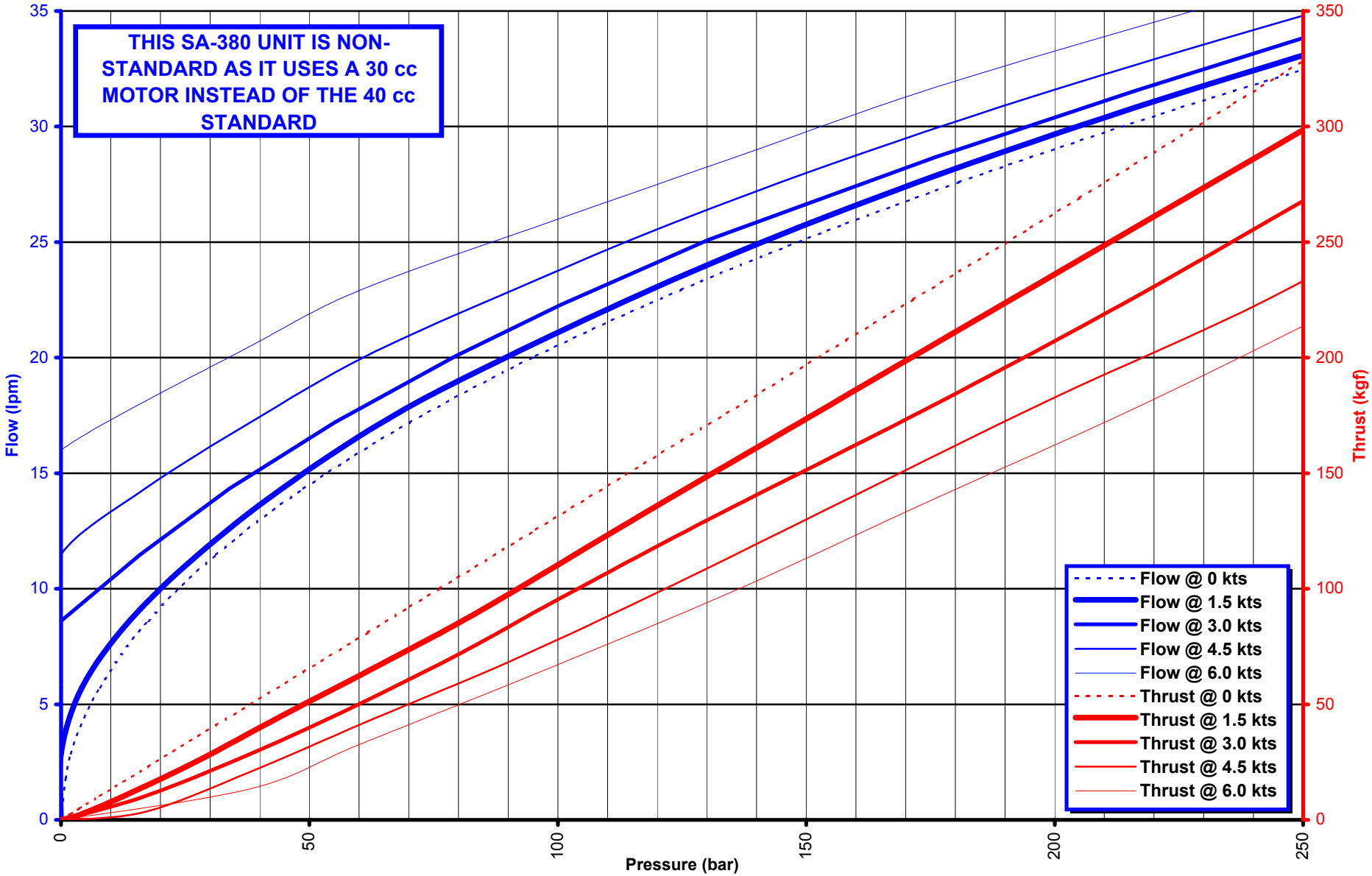


Copies of Certified DNV data sheets available

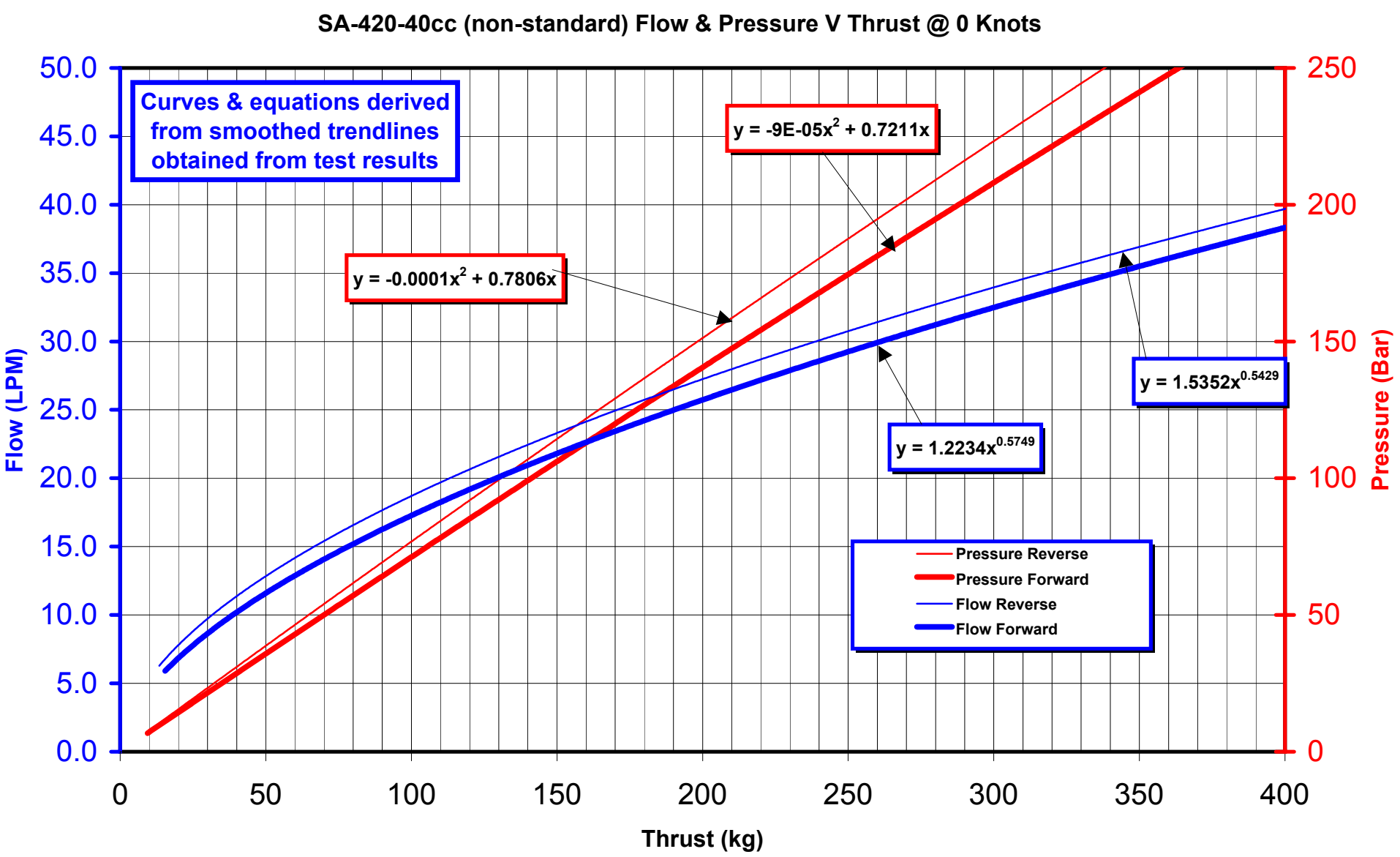
Curves & equations derived from DNV witnessed bollard test results


SA-380-30cc (non-standard) Flow & Pressure V Thrust @ 0 Knots
Curves & equations derived from smoothed trendlines obtained from test results
y = -0.0001x2 + 0.7993x
y = -0.0003x2 + 0.9009x
y = 1.9289x0.4956
y = 2.1098x0.4705
Flow Reverse
Flow Forward
Pressure Forward
Pressure Reverse
Flow (LPM)
Pressure (Bar)
Bollard Thrust (Kg)
50.0
40.0
30.0
20.0
10.0
250
200
150
100
50
0
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320

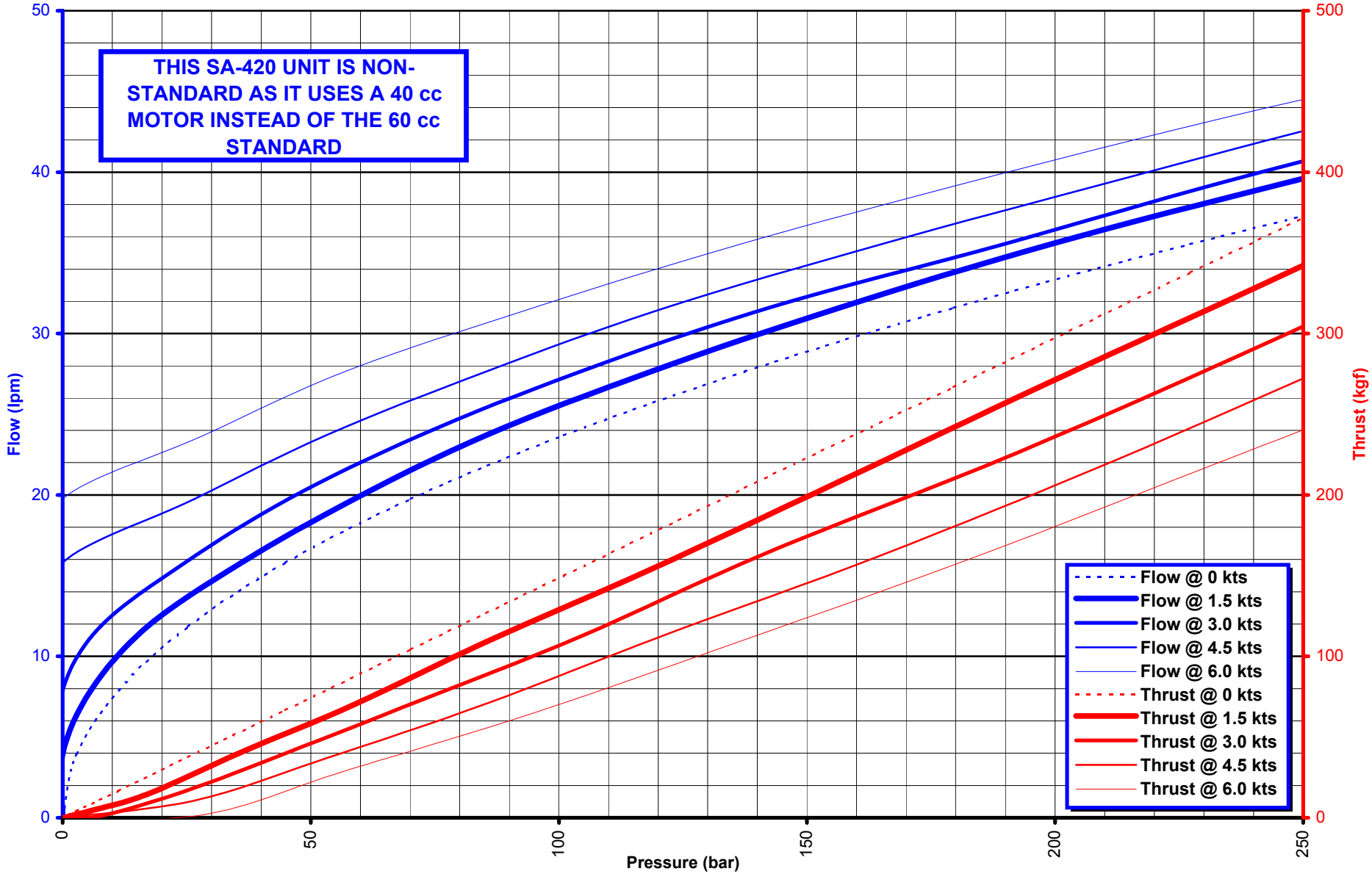
SA-380-30cc-SF (non-standard) Flow & Thrust V Pressure at Various Advance Speeds



Curves & equations derived from DNV witnessed bollard test results


SA-420-40cc (non-standard) Flow & Pressure V Thrust @ 0 Knots
Curves & equations derived from smoothed trendlines obtained from test results
y = -9E-05x^2 + 0.7211x
y = -0.0001x^2 + 0.7806x
y = 1.5352x^0.5429
y = 1.2234x^0.5749
Pressure Reverse
Pressure Forward
Flow Reverse
Flow Forward
Flow (LPM)
Pressure (Bar)
Thrust (kg)
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
250
200
150
100
50
0
0
50
100
150
200
250
300
350
400

SA-420-40cc-SF (non-standard) Flow & Thrust V Pressure at Various Advance Speeds



Copies of Certified DNV data sheets available

Curves & equations derived from DNV witnessed bollard test results